FRI REPORT

Focused Remedial Investigation (FRI) Report *Standard Chlorine Chemical Company Inc. and Standard Naphthalene Products Inc. Site Kearny, New Jersey*

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1.0 INTRODUCTION

Standard Chlorine Chemical Company, Inc. (SCCC) retained Environmental Resources Management, Inc. (ERM) to complete a Focused Remedial Investigation (FRI) of the former lagoon area at the SCCC and the Standard Naphthalene Products, Inc. (SNP) properties in Kearny, New Jersey (the "SCCC Site" or the "Site"). The purpose of the FRI is to supplement site characterization data collected during previous Remedial Investigation (RI) activities to more fully characterize and understand the environmental conditions with respect to the former lagoon at the Site. To help expedite the implementation of any appropriate remedial actions for the lagoon area (i.e., the eastern portion of the site), the FRI was focused on the lagoon area only, and was not intended to address the entire property. Specifically, the FRI was intended to provide sufficient information to support completion of a Proposed Remedial Action Plan (PRAP) for remediation of the lagoon area. The PRAP will focus on the selection of appropriate, technically feasible, cost-effective remedial alternatives for impacted environmental media at the site. This report has been developed to support and to be included as an appendix to the PRAP for the lagoon area.

1.1 REPORT ORGANIZATION AND FORMAT

This report is organized into the following four major sections, and accompanying attachments:

- Section 1 - Introduction: presents the location and setting of the Site, regulatory background, investigation objectives, the regional geology and hydrogeology, and a summary of site-specific geology;
- Section 2 - Summary of Site Conditions and FRI Activities: presents a summary of site conditions based on previous studies, and a discussion of the field investigative activities and methods implemented to complete the FRI;
- Section 3 - Results and Discussion: presents a discussion of the results of the FRI. An evaluation of fate and transport is presented to unify the understanding of the conditions at the former lagoon;
- Section 4 - Conclusions and Recommendations: presents a summary of the major conclusions from the FRI, and recommendations for addressing any concerns identified; and
- Attachments: provide supporting information and documentation.

1.2 LOCATION AND SETTING

The SCCC site consists of approximately 25 acres bounded to the north by property owned by Maxus Energy (formerly Diamond Shamrock Company, Inc.); to the south by Koppers Company, Inc. (Koppers); to the east by the Hackensack River; and to the west by the Belleville Turnpike. The site location is shown on Figure 1-1, and the general site layout is shown on Figure 1-2.

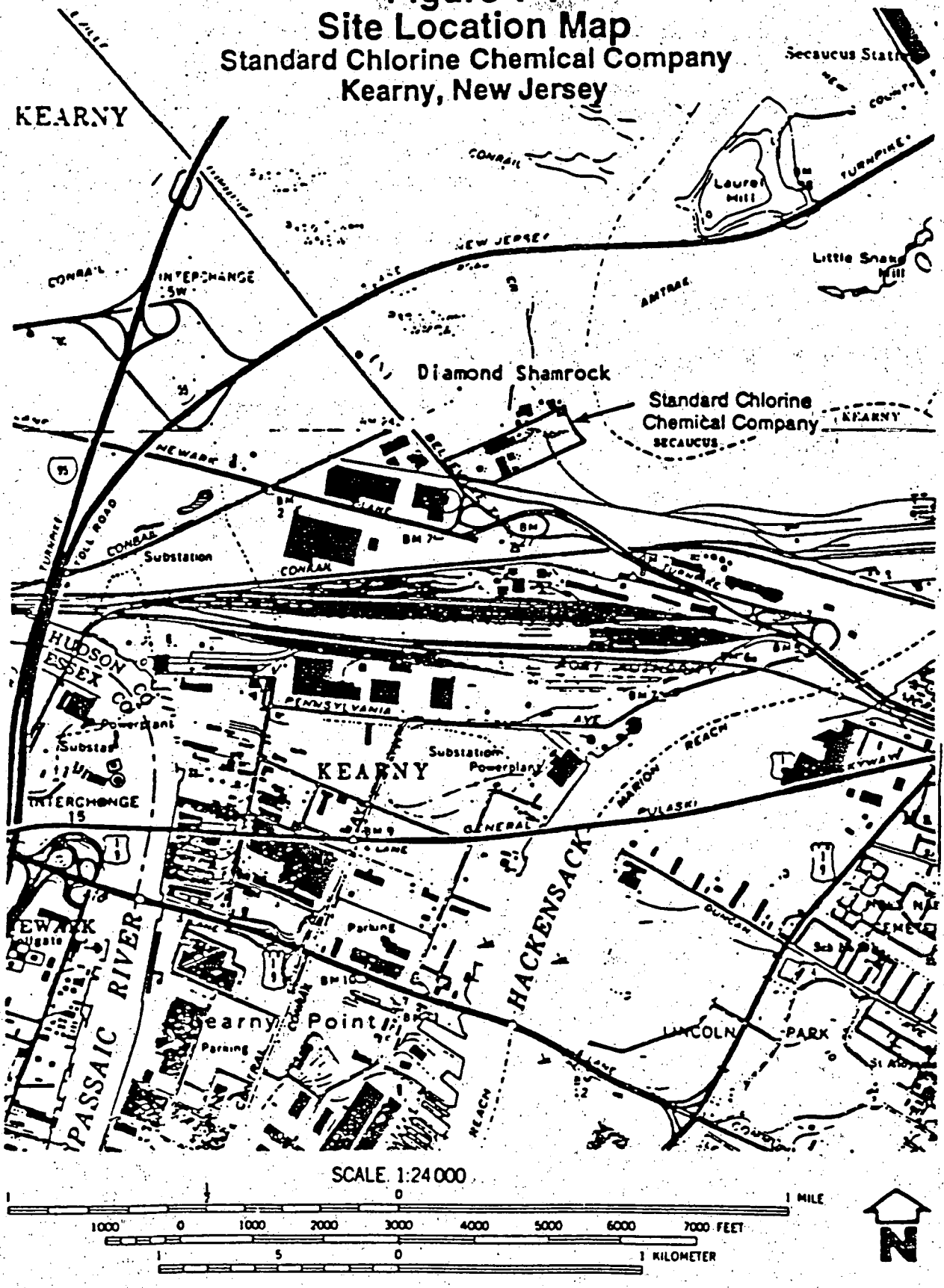
The property generally consists of two distinct areas; the western two-thirds which contains the previous plant manufacturing facilities; and the eastern third which contains the former lagoon. The current configuration of the former lagoon is shown on Figure 1-2 as an oval shaped depression on the eastern portion of the property. Residual sludges remain in the former lagoon.

Topographically, the ground surface is relatively flat across the Site, primarily varying from 3 to 8 feet in elevation above sea level (ft. msl), with a total range of approximately 0 ft. msl to 10 ft. msl. The highest elevation is at the southeastern corner of the site. The eastern and western portions of the site generally slope to a central drainage swale, which directs water to the south and then to the east along the southern property boundary for discharge to the Hackensack River via the south outfall. In addition to on-site drainage, this ditch receives some sheet flow run-off from off-site commercial, and industrial properties to the west and south of the site. The south outfall is equipped with a tide gate to prevent backflow during high tide.

A 24-inch diameter underground concrete stormwater pipe is present along the northern property boundary of the Site. This pipeline receives run-off via drop inlets from the Maxus property to the north of the SCCC property, as well as drainage from off-site commercial, and industrial properties to the west. The stormwater pipe discharges to Hackensack River through an outfall which is located north of the Site. The outfall is equipped with a tide gate to prevent backflow during high tide.

The Hackensack River is adjacent to the entire eastern property boundary. The Hackensack River is tidally influenced and discharges to Newark Bay to the south. The overall direction of flow in the Hackensack River adjacent to the Site is from north to south. The Hackensack River in the vicinity of the Site receives some sheet flow run-off from the SCCC property, stormwater discharge from the southern drainage ditch, run-off and related discharges from properties to the north of SCCC via the north stormwater pipe, and surface water from downstream when the direction of flow reverses during high tide.

Figure 1-1
Site Location Map
Standard Chlorine Chemical Company
Kearny, New Jersey



1.3 REGIONAL GEOLOGY AND HYDROGEOLOGY

The SCCC Site is located in the Hackensack River Basin of northeastern New Jersey. This basin is located within the glaciated section of the Piedmont Physiographic Province. In general, the Piedmont is characterized by continental bedrock, and may be overlain by a veneer of soil and surficial sediments. In the Hackensack River Basin, sediments associated with glaciers and recent stream deposits overlie the bedrock.

1.3.1 *Bedrock*

The Triassic age Newark Group is the bedrock present in this area of New Jersey. The Newark Group consists of three major formations: the Stockton Formation; the Lockatong Formation; and the Brunswick Formation. The Brunswick is the bedrock that is encountered throughout most of the Hackensack River Basin. The Brunswick Formation consists of reddish-brown mudstone, siltstone, sandstone and conglomerate. The bedding planes generally strike north-northeast, and dip northwest at shallow angles. A prominent set of steeply dipping joints parallels the bedding strike, and a less prominent set of nearly vertical joints parallels the bedding dip.

There is little primary porosity associated with the bedrock in which ground water can be stored and transmitted. Ground water is stored predominantly within bedding planes, and secondary features such as fractures and joints. Ground water flow occurs primarily along the bedding planes and secondary features. The bedrock is a source of ground water for industrial use in the area.

1.3.2 *Overburden*

Overburden sediments cover the bedrock in most of the Hackensack River Basin. These sediments are associated with several major advances of continental glaciers during the Pleistocene Epoch, and more recent Holocene Epoch alluvial stream deposits and man-made fill.

The Pleistocene sediments consists of sand, gravel, silt and clay from glacial till and stratified drift deposits. The thickness of the till is variable, and averages approximately 25 feet. Locally, the till may exceed 165 feet in thickness. The stratigraphy of the Pleistocene deposits consists of two major types: (1) sands and gravels overlain by (2) clay and silt. The sands and gravels are present on top of bedrock, and are associated with fluvial deposits which were scoured by the glaciers from the underlying bedrock. The clay and silt overlies the sand and gravel and were deposited in fresh-water lacustrine environments (lakes) which formed as the glaciers retreated. The clays and silts are typically varved (alternating layers of clay and silt).

Holocene sediments are thin, of small areal extent, and were deposited on top of the Pleistocene sediments. The Holocene sediments consist of either sand, gravel, silt, clay, peat and/or root mat. Holocene sediments may be up to 10 to 50 feet thick locally. There is also man-made, artificial fill overlying natural Holocene deposits throughout the Hackensack River Basin.

Ground water in the sediments occurs in the pores between the grains as a primary porosity. Small quantities of ground water are stored in the till which overlies bedrock, due to their poorly sorted nature and corresponding low permeability. Deposits of varved silt and clay are poorly permeable, and impede the movement and discharge of ground water. Most water is stored in the well-sorted Pleistocene sands and gravels, where present. Since the unconsolidated sediments are thin, they are not a major source of ground water and are typically considered local water table aquifers.

1.3.3 *Summary of Site-Specific Geology*

In general there is man-made fill present at the ground surface. This fill is underlain by peat/meadow mat. Together the fill and peat/meadow mat are up to 12 feet thick. The fill and peat/meadow mat are underlain by a Holocene sand layer. This sand appears present beneath the entire lagoon area and is 4 to 6 feet thick. A varved clay (Pleistocene Age) unit is present beneath the sand. The thickness of the clay is estimated at greater than 40 feet in thickness based on subsurface data from adjacent sites. This sequence of fill/peat underlain by sand, which is underlain by varved clay (glacial till) comprises the overburden stratigraphy at the Site. The bedrock beneath the overburden consists of the Triassic age Brunswick formation.

A more detailed discussion of the site-specific geology is presented in Section 3 of this report.

1.4 *REGULATORY BACKGROUND AND SUBMITTALS*

Between 1983 and 1987, several areas of concern were identified by the New Jersey Department of Environmental Protection (NJDEP) at the Site. In 1989, an Administrative Consent Order (ACO) was entered into between NJDEP and SCCC. The ACO required SCCC to plan and implement interim remedial measures, a remedial investigation of the Site, and an evaluation and selection of an appropriate remedial action alternative or alternatives.

In accordance with the ACO, and a Remedial Investigation (RI) Work Plan approved by the NJDEP on 26 October 1990, Phase I RI activities were initiated in December 1990. Phase II RI activities were subsequently

conducted at the direction of the NJDEP, and a Draft RI Report was submitted to the NJDEP in May 1993. A brief summary of the relevant RI results is presented in Section 2.0 of this report.

In compliance with the ACO, various Interim Remedial Measures (IRMs) were also completed at the site by SCCC to secure the site against unauthorized entry, to prevent stormwater overflow from the lagoon, and to prevent possible releases of product from on-site storage tanks. In addition, IRMs were implemented at the site by Maxus Energy to mitigate risks of human exposure to the chromium ore residue covering most of the SCCC property. This IRM included paving traffic areas with asphalt, and covering non-traffic areas with a geotextile and gravel. These IRMs are discussed in greater detail in the Draft RI Report.

In response to the NJDEP's 17 August 1995 comments on the May 1993 RI Report, as well as subsequent conversations with the NJDEP, a Focused Remedial Investigation (FRI) Work Plan was developed to complete the investigation of the lagoon area and provide for the development of an appropriate remedy based on the FRI Results. The FRI Work Plan dated 15 April 1996 was approved by the NJDEP via a letter dated 31 May 1996.

1.5 *FRI OBJECTIVES*

The purpose of the FRI was to satisfy the following two major objectives:

- to more fully characterize and understand the overall conditions with respect to the former lagoon at the Site, specifically, to understand the hydrogeology and potential dense non-aqueous-phase liquid (DNAPL) migration pathways in the vicinity of the former lagoon, and the potential impacts on the Hackensack River; and
- to provide sufficient information and a more complete understanding of the former lagoon to support completion of a PRAP, and select an appropriate, technically feasible, cost-effective remedial alternative for soil, waste, and ground water (if warranted).

An additional component of the investigation was to determine how sediments and surface water may be affected by the presence of the former lagoon and the existing surface drainage features (i.e., the north stormwater pipe and the south drainage ditch).

These objectives were met through implementation of the scope of work discussed in Section 2 of this report.

2.0 SUMMARY OF SITE CONDITIONS AND METHODS SUMMARY FOR FRI INVESTIGATION ACTIVITIES

2.1 SUMMARY OF SITE CONDITIONS

A summary of the site conditions in the lagoon area based on the previous site investigation activities is presented below. A more detailed discussion of these previous activities, as well as additional supporting information and documentation, are presented in the May 1993 RI Report and the April 1996 FRI Work Plan.

2.1.1 *Soils*

As discussed above, the soils at the Site generally consist of the following units from top to bottom: 8 to 10 feet of fill; 2 to 5 feet of organic silt, humus and peat ("meadow mat"); 4 to 7 feet of fine to coarse Holocene Age silty sand; and a relatively thick and extensive layer of stiff Pleistocene clay. The clay unit is underlain by the shales and sandstones of the Brunswick formation. The shallow water table is within a few feet of the ground surface across the Lagoon Area.

Lagoon area soils exhibit high levels of chromium, generally attributable to the surface slag fill material which originated from the adjacent Maxus property. Elevated levels of benzene, naphthalene, and many chlorinated organics were also detected in lagoon area soils. Potential sources for these organic constituents include the lagoon, previous storage tanks, and off-site sources.

2.1.2 *Lagoon Sludges*

The waste lagoons are two contiguous bodies containing a combined estimated volume of 7,400 cubic yards of material. Although two physically distinct layers of waste sludge were detected in the lagoons during previous investigations, the constituents detected in the sludge samples from both layers were fairly consistent. Naphthalene was the most abundant constituent detected in the lagoons, with polynuclear aromatic hydrocarbons (PAHs) and phenols as the next most abundant constituents. Dichlorobenzenes, benzene, ethylbenzene and toluene were detected at lesser concentrations. Dioxins were also detected in the lagoon sludges.

Because the waste lagoons are unlined and the base of the waste is below the elevation of the shallow ground water table, and considering the relatively high level of constituents detected in the lagoon sludges, the

waste lagoons currently represent the principal potential source of contaminant releases at the Site.

2.1.3 *DNAPL*

Dense non-aqueous-phase liquids (DNAPLs) were not detected in the lagoon area during the previous RI activities, although some free-phase product was detected in monitoring well MW-15L and soil boring SB-2 between Buildings 2 and 4 during the RI. However, as recommended by the NJDEP in their 11 August 1995 letter regarding the May 1993 RI, the potential presence of DNAPL at the Site was re-evaluated because of the detection of DNAPL in a monitoring well on the adjacent Maxus Energy site (i.e., MW-8L).

A re-evaluation of DNAPL at the Site during preparation of the FRI Work Plan included a review of previous sampling data and boring logs, and an on-site survey of existing monitoring wells. The review of previous data indicated the potential for DNAPL collection on the meadow mat surface as well as on the underlying clay surface. During the preparation of the FRI Work Plan, a site visit and well survey was conducted with an interface probe to determine the presence or absence of DNAPL in the on-site monitoring wells. A summary of the DNAPL survey results, as well as the results of a follow-up survey that was conducted with a different type of interface probe (i.e., a conductivity probe), are presented on Table 2-1. As presented on Table 2-1, DNAPL was detected in four of the on-site monitoring wells. DNAPL was not detected in any of the shallow monitoring wells, nor was DNAPL detected in MW-15L as it was during the RI. Based on a review of DNAPL thickness results and the well construction data, it was concluded that wells installed within the clay unit act as sumps for the collection of DNAPL, and the thickness of DNAPL measured in the wells was generally consistent with the depth into which the well is set in the clay. It should be noted that none of the shallow wells were constructed in a fashion that would readily provide for the accumulation or detection of DNAPL (i.e., none of the wells were constructed as sumps into the meadow mat).

To compare the composition of DNAPL at the Site to the composition of DNAPL collected from the adjacent Maxus Energy site, samples of DNAPL were collected from the on-site wells in which DNAPL was detected. The samples from select wells were also analyzed for physical properties that are important to the understanding of potential DNAPL migration. A summary of the DNAPL sample results is presented on Table 2-2. Because some of the constituents detected in the MW-8L DNAPL sample (e.g., trichloroethylene and tetrachloroethylene) are not related to any of the documented site activities, a potential off-site source of these contaminants is suspected.

Because DNAPL migration is typically controlled by gravity rather than ground water flow directions, the topography of the meadow mat and clay surfaces are expected to influence DNAPL migration pathways at the Site. Preliminary topographic maps of the meadow mat and clay surfaces were constructed based on existing boring logs, and were previously presented in the FRI Work Plan. Additional data has been collected during the FRI to help refine the topography of these units as described later in this report.

2.1.4 *Surface Water*

The surface water samples taken from the on-site drainage ditches during the previous RI work indicated the presence of benzene, chlorobenzene, and toluene. Semi-volatile compounds were also detected including dichlorobenzenes, trichlorobenzene, phenols, and naphthalene. Chromium, along with other metals were detected consistently in the surface waters. Based on the condition of these drainage features, the condition of the areas which drain into them, and the elevated constituent levels detected, these drainage features to the south of the lagoon area was identified in the May 1993 RI as potential constituent migration pathways.

Because the Hackensack River is adjacent to the lagoon area, and at least some fraction of the Site ground water is believed to discharge directly into the river, the quality of surface water in the Hackensack River is critical to the understanding of site conditions and potential impacts. Limited surface water quality data collected from the Hackensack River during the investigations conducted at the adjacent sites generally do not indicate a concern. However, in accordance with the FRI Work Plan, additional surface water samples were obtained and analyzed as discussed later in this report.

2.1.5 *Sediments*

Sediment samples from the Hackensack River were not collected during the previous RI activities at the Site. Sediment sampling conducted during an investigation of the adjacent Maxus Energy site indicate the presence of constituents potentially related to the lagoon area, particularly in the sediment samples collected from downstream of the North Outfall (see Figure 2-1). The results of these analyses, along with a figure showing the sample locations, were provided to SCCC by the NJDEP in the 11 August 1995 letter. In an effort to obtain a better understanding of the relationship between sediment quality and the North Outfall, and in accordance with the FRI Work Plan, SCCC performed additional sampling of the sediments as discussed later in this report.

Table 2-1
DNAPL Thickness Measurements
Standard Chlorine Chemical Company
Kearny, New Jersey Facility

Well No.	Date	DNAPL Thickness (ft)*	Date	DNAPL Thickness (ft)**	Approx. Depth Well is Set into Confining Clay (ft)
MW-8L	9/19/95	2.51	9/25/95	2.89	2.4
MW-12L	9/19/95	0.01	9/25/95	1.1	2.1
MW-13L	9/19/95	0.05	9/25/95	1.52	1.5
MW-14L	9/19/95	0.73	9/25/95	0.79	1.5

* Measured with Oil/Water Interface Probe (Marine Moisture Control)
** Measured with Conductivity Probe (Marine Moisture Control)

Table 2-2

DNAPL Characterization Sampling Results

Standard Chlorine Chemical Company

Kearny, New Jersey

Well No.	*MW-8L*	*MW-12L*	*MW-13L*	*MW-14L*	*Practical*	*EB-1*	*TB-1*
Date Sampled	*9/19/95*	*9/19/95*	*9/19/95*	*9/19/95*	*Quantitation*	*9/19/95*	*9/19/95*
Time Sampled	*1200*	*1320*	*1250*	*1235*	*Limit*	*1225*	*1400*
ERM TR#	*7461*	*7465*	*7464*	*7563*	*(mg/kg)*	*7462*	*7466*
	(mg/kg)	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/L)*	*(mg/L)*
trichloroethylene	8,600	U	U	U	2,500	U	U
tetrachloroethylene	11,000	U	U	U	2,500	U	U
chlorobenzene	9,000	1,700 J	U	U	2,500	U	U
1,3-dichlorobenzene	74,000 J	40,000	3,600 J	41,000	5,000	U	U
1,2-dichlorobenzene	160,000	99,000	12,000	45,000	5,000	U	U
1,4-dichlorobenzene	68,000 J	49,000	6,500	54,000 J	5,000	U	U
naphthalene	41,000 J	200,000	150,000	75,000	2,500	U	U
1,2,4-trichlorobenzene	620,000	160,000	99,000	770,000	2,500	U	U
viscosity (SSU)	30	NA	37	NA		NA	NA
specfic gravity (unitless)	1.3789	NA	1.3373	NA		NA	NA

Notes:

J: Indicates an estimated value

U: Indicates compounds was analyzed for but not detected

NA: Not analyzed

EB: Equipment blank

TB: Travel Blank

2.1.6 *Ground Water*

Ground contamination was detected at varying concentrations across the Site in both the upper and lower water bearing zones (i.e., the fill unit and the sand unit underlying the meadow mat, respectively) during previous investigation activities. Levels of volatile and semi-volatile organic constituents were detected in the lower ground water unit at concentrations above 100 mg/L near the lagoon and other source areas. It is currently suspected that this contamination is associated with known historical activities and the wastes present in the lagoon.

As presented in the May 1993 RI, ground water flow across the Site is generally to the south, with a lesser component of flow towards the Hackensack River. A follow-up water level study was conducted during preparation of the FRI Work Plan following receipt of the NJDEP's 11 August 1995 letter to re-evaluate the ground water flow directions across the Site, particularly in the lagoon area. Ground water elevation contours for both the upper fill unit and lower sand unit from this follow-up study were presented in the FRI Work Plan. In general, the flow directions and ground water contours measured during this study were similar to those presented in the May 1993 RI Report, including the apparent mounding of water in the northeastern portion of the Site in both the upper and lower units. However, in order to confirm ground water flow directions, SCCC performed a more comprehensive water level and tidal survey of both the upper and lower water bearing zones in accordance with the FRI Work Plan as discussed later in this report.

2.2 *METHODS SUMMARY FOR FRI INVESTIGATION ACTIVITIES*

The FRI included the following major activities:

- A soils/DNAPL investigation of the former lagoon area including the installation of 14 soil borings, and discrete sampling of the soil matrix to determine the presence or absence of free product, and to estimate the topography of the surface of the meadow mat and clay units;
- A surface water and sediment investigation of the Hackensack River, North Outfall, and South Outfall, including surface water and sediment sampling;
- Surveying of the monitoring wells and soil boring locations installed during the FRI for horizontal and vertical control;
- A hydrogeologic investigation including synoptic water level measurements in all on-site monitoring wells and selected off-site wells in order to develop an understanding of regional ground water flow conditions;

- An investigation of ground water/surface water interactions through a continuous water level (tidal) study in select monitoring wells and the Hackensack River; and
- Activities to locate and formally abandon the old on-site production well which was drilled in 1917.

The field sampling procedures and analytical methods conducted during the FRI have been completed in compliance with the NJDEP-approved FRI Work Plan, as well as the applicable NJDEP field methods and protocols described in NJDEP's May 1992, Field Sampling Procedures Manual.

2.2.1 *Abandonment of Old Production Well*

In accordance with the FRI Work Plan, SCCC attempted to locate the old on-site production well which was drilled in 1917. During the soil boring program, ERM field personnel were able to locate the old production well (see Figure 2-1). The well was field measured to be 10 inches in diameter at the surface and approximately 368 feet deep. The water surface in the well was measured at the top of the well casing (which was approximately 12 inches below the ground surface). Since an estimated 1,200 gallons of water exists in the well, SCCC requested guidance from the NJDEP regarding disposal of the well water. Following a visit to the site by the NJDEP in September 1996 and a series of telephone conversations in October 1996 with the Geologic Technical Coordinator, Ms. Linda Welkom, the NJDEP requested that SCCC develop a work plan for the abandonment of the well. In addition, on 11 October 1996, SCCC received a letter from the NJDEP Bureau of Water Allocation to have the old production well formally abandoned within sixty days.

On 14 November 1996, a brief work plan for the closure/abandonment was provided to the NJDEP. SCCC is presently waiting on the NJDEP for comment regarding the work plan.

2.2.2 *Geophysical Survey*

A geophysical investigation was conducted in an attempt to map the surface of the clay unit. Because DNAPL has been detected on the surface of this unit, and because DNAPL flow is generally controlled by gravity (i.e., it flows downhill) rather than ground water flow direction (because of its greater density than water and the fact that it is present as a non-aqueous phase), the surface topography of the clay layer is believed to influence the direction of DNAPL migration within the lagoon area. Secondary objectives of the geophysical investigation were to estimate the surface topography and thickness of the meadow mat layer, as well as the lateral extent of the sludge lagoons. The geophysical survey concentrated on the lagoon area, specifically the area extending from the Hackensack River to west of the Conrail right-of-way, for a total area of approximately 400 ft by 500 ft.

Because of the potentially unfavorable site conditions (e.g., chromium fill), the application of two geophysical methods using a multi-phase approach was planned. The methods used during this investigation were ground penetrating radar (GPR) and seismic refraction.

2.2.2.1 *Phase I Geophysical Investigation*

As indicated in the FRI Work Plan, the first phase of the geophysical investigation (Phase I) was completed to evaluate the potential success of each geophysical method at meeting the objectives. If it was determined during Phase I of the investigation that neither of the planned methods would be able to meet the objectives, Phase II would not be initiated, and other methodologies (e.g., conductivity) would be considered.

Ground Penetrating Radar (GPR) Method

The GPR technique is used to map subsurface features by radiating high frequency radio waves downward into the subsurface. Reflections from buried objects or interfaces having different electrical properties are received by an antenna and are sent to a graphic recorder.

The largest limitation to using GPR is that very electrically conductive near-surface materials (clay, reinforced concrete, certain types of fill materials, etc.) can absorb much of the radio impulse energy thereby reducing the effective depth of penetration. The degree of signal attenuation is very site-specific and is best evaluated on location. If signal attenuation caused by subsurface conditions becomes a problem, lower frequency antennas may be used at the expense of poorer resolution.

To test the potential success of the GPR method at this Site, several traverses of data were collected and compared to existing borehole information.

Seismic Refraction Method

During the Phase I geophysical method evaluation, the seismic refraction method was also tested for the ability to resolve the clay horizon. The seismic refraction method is based upon the generation and propagation of an elastic wave into the subsurface. An energy source (e.g., sledge hammer/shot plate, elastic wave generator, etc.) initiates a disturbance at the ground surface which results in the generation of an elastic wave. The wave travels into the subsurface at a velocity that is defined by the elastic properties of the upper medium. When the wave contacts a medium that possesses contrasting elastic properties, the wave is re-directed along the contact interface. This signal then returns continuously to the ground surface where it is detected with geophones and recorded for additional processing.

A potentially limiting factor to the collection of seismic refraction data is noise, or vibrations from highway traffic, airplanes, trains or industrial processes. In order to attempt to overcome noise interferences, repeated hammer blows are used to enhance the seismic signal.

To test the application of seismic refraction to this Site, a single seismic spread of data was collected adjacent to an existing well. The results of this spread was evaluated for the ability to resolve the target using the generalized reciprocal method (GRM) of seismic refraction interpretation.

Results of the Phase I Geophysics survey are presented in Section 3 of this report.

2.2.3 *Soil Boring Installation*

Soil boring installation and sampling of the fill, meadow mat, and the lower sand unit at the surface of the clay (i.e., for DNAPL presence or absence) was conducted between 5 and 16 August 1996. Thirteen soil borings (SB-2 through SB-14) were installed adjacent to the current extent of the former lagoon in the eastern portion of the Site (Figure 2-1). One soil boring (SB-1) was installed at the westernmost portion of the eastern portion of the Site to help delineate the extent of free product. Soil sampling of the base of the sand unit was conducted to help identify where free-phase product from the former lagoon may have migrated. In addition, selected soil samples which indicated high organic vapor analyzer (OVA) readings were targeted for laboratory analysis.

The fourteen soil borings were completed with a truck-mounted rig using the mud-rotary drilling method because of the potential lifting of the outer protective casing used to case off the upper fill unit was considered to be a concern if hollow stem auger equipment were used to drill through the meadow mat to the lower sand unit. The drill tip was advanced to the desired depth while jetting in drillers' mud to displace the overburden soils and prevent migration of constituents along the borehole which was created. The terminal depth of each boring was the top of the clay unit. Continuous two-inch diameter split-spoons were collected from the ground surface to approximately one foot into the clay unit. The soil boring logs are presented as Attachment 1.

2.2.3.1 *Sample Collection*

Soil samples were collected from each split-spoon sample collected through the fill, meadow mat, and sand units. Soil samples were removed from the split-spoon using a dedicated pre-decontaminated stainless steel spatula. Following collection, the samples were immediately transferred to two 4-ounce laboratory-supplied glass jars and packed to minimize headspace. The 4-ounce jars were stored on ice for selection of which samples would be analyzed by the analytical laboratory. If sufficient

sample remained, it was placed in a 500-mL ball jar for headspace analysis. Labels were then placed on the sample jars, and the samples were placed in zip-lock baggies and stored on ice. Disposable surgical gloves were worn and changed between each split spoon sample. The split-spoons were decontaminated in the field between samples according to the procedures outlined in the FRI Work Plan.

2.2.3.2 *Laboratory Analysis*

Eight of the soil samples collected were submitted for laboratory analyses. Each sample was analyzed using method 8260A to target the site-related volatile organic compounds ("VOCs") and the lighter-weight semi-volatile compounds. The samples were analyzed by a New Jersey-certified laboratory, Core Laboratories, Edison, New Jersey. The samples were selected from borings in which waste materials were encountered above the clay and/or where field screening of the sample headspace indicated elevated organic vapor concentrations. One sample from the upper fill unit and seven samples from the top of the clay were selected for laboratory analyses.

In addition to the soil samples, quality assurance/quality control (QA/QC) samples including two matrix spike/matrix spike duplicate (MS/MSD) samples, an equipment blank, and three trip blanks were submitted for laboratory analysis. Each trip blank consisted of demonstrated analyte-free water provided by Core Laboratories and contained in two 40-mL screw cap vials with Teflon®-lined septa. The trip blanks accompanied the sampler and sample bottles during the sampling process, with one trip blank submitted for analysis of VOCs by method 8260A on each day that soil samples were submitted to the laboratory for analysis. The equipment blank was collected to ensure that sampling equipment is clean and that the potential for cross contamination minimized by equipment decontamination. This blank was collected by pouring the laboratory-supplied analyte-free water over a decontaminated split spoon and into empty laboratory-supplied sample bottles. The equipment blank was submitted to the laboratory for analysis of VOCs by method 8260A.

Chain-of-custody and QA/QC procedures were in accordance with the FRI Work Plan and the NJDEP Technical Requirements for Site Remediation (NJAC 7:26E). To enable thorough data validation, the results were provided with full regulatory deliverable format.

2.2.4 *Surface Water and Sediment Sampling*

Surface water and sediment sampling was conducted on 28 August 1996. The timing of the collection of these samples was set with he tidal cycle and the lunar events (i.e., low tide during a full moon). The samples were collected at low tide based on the review of tidal fluctuation at the Kearny

site from published tidal information. Surface water and sediment samples were collected to assess potential constituent migration pathways and impacts from the lagoon area to the Hackensack River.

2.2.4.1 *Sediment and Surface Water Sample Collection*

Surface water samples were collected during low tide on 28 August 1996. Low tide was estimated using the method described in the East Coast of North and South America, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service, 1996 Tide Tables. Low tide was estimated for the closest gaging station to the Site, being the Hackensack River at Kearny Point.

Surface water samples were collected prior to sediment sampling at each station to prevent the capture of disturbed sediment in the water samples. Surface water sampling from the Hackensack River proceeded from the location farthest downstream (SW-2) to the upstream locations (SW-1 and SW-3) to minimize potential matrix contamination by sediment and other material which may have been suspended in the stream as a result of sampling activities. River flow and direction were established on a visual basis, taking into consideration the low tide condition which results in river flow from north to south.

Samples were immediately placed in zip-lock baggies and stored on ice. Field measurement of dissolved oxygen, pH, Eh, Sc, and temperature were obtained immediately following sample collection at each location. A grab sample collected in a beaker was used to obtain field measurements. All measurement probes were rinsed with distilled water between samples.

During surface water/sediment sampling, the bank of the Hackensack River was observed for seeps. No seeps were observed during the surface water/sediment sampling events.

The sampling locations were accessed from a row boat. Approximate sample locations were measured as distances from the bank of the Hackensack River using a steel tape measure which was secured along the bank of the creek. An anchor was used to keep the boat stationary during sample collection. Sediment samples were collected using a hand-operated core sampler with a 12-inch by 3-inch ID stainless steel core tube that was fitted with a decontaminated clear plastic liner sleeve. The liner sleeve enabled the sediment sample to be easily extruded from the core sampler so it could be visually observed for potential stratification, staining and color. Sampling began closest to the creek bank and extended outward farther from the creek bank along each line as shown on Figure 2-1. The coring device maximized the collection of sediment fines and minimized washing of the sample so that an undisturbed core of sediment was collected. For the volatile fraction, the sediment sample was

transferred directly to the appropriate labeled sample container using a decontaminated, dedicated stainless steel spatula. Samples were immediately placed in a zip-lock baggie, and the samples were stored on ice. The coring device, bowl, and spatula were decontaminated prior to initial use and after the collection of each sample in accordance with the standard NJDEP procedures as presented in the FRI Work Plan. Disposable surgical gloves were worn and changed between each sampling location.

2.2.4.2 *Laboratory Analysis*

Sediment and surface water samples were analyzed using method 8260A to target site-related VOCs and the lighter-weight semi-volatile organic compounds. As with the soil samples, analyses were completed by Core Laboratories, Edison, New Jersey. QA/QC samples including one equipment blank and one trip blank were also submitted for analysis of VOCs by method 8260A. Analytical results were provided with full data deliverables.

In addition to the VOC analyses, sediment samples were analyzed for total organic carbon (TOC) and grain size distribution, and surface water samples were analyzed for hardness. Sediment samples were collected in one-liter jars for grain size analysis and TOC.

2.2.5 *Surveying*

The FRI monitoring wells and soil borings were surveyed to the New Jersey State Plane Coordinate System to provide vertical and horizontal control. Surveying was conducted by a New Jersey-certified surveyor to the following specifications:

- Established New Jersey Geological Survey (NJGS) or United States Geological Survey Benchmarks (USGS) were located for control;
- Horizontal and vertical control for each location from the horizontal datum NAD 27;
- New Jersey State Plane Coordinates for each location reported to an accuracy of 0.01 New Jersey Plane Coordinate Units, and the latitude and longitude for each location reported to an accuracy of 0.001 degrees;
- The elevation of the top of inner casing, top of outer casing, and ground surface for each monitor well to an accuracy of 0.01 feet. All other locations measured to the same accuracy with respect to ground surface. All elevations referenced to the New Jersey Vertical Datum 1929; and
- All survey data reported with a registered State of New Jersey Land Surveyors Seal.

An AutoCAD drawing of all surveyed locations and the Site property boundaries was provided by the surveyor and has been used to prepare the figures for this report. Surveying data for the on-site monitoring wells and soil boring locations are presented as Attachment 2.

2.2.6 *Water Level Monitoring*

Water level monitoring included the following:

- A synoptic water level measurement study to develop ground water contour maps for the upper and lower water systems; and
- A continuous water level study in select monitoring wells and in the Hackensack River.

Synoptic water level measurements have been used to develop ground water contour maps to determine ground water flow directions in the shallow fill/meadow mat unit and in the lower sand unit. These data have also been used to calculate vertical and horizontal gradients between the two units. Synoptic water level measurements were also collected during predicted high tide and low tide in conjunction with the continuous water level study. The continuous water level study was conducted to evaluate aquifer response to tidal fluctuations and to determine whether there is hydraulic connection between the on-site ground water units and the Hackensack River.

2.2.6.1 *Synoptic Water Level Monitoring*

Water levels were monitored using an electronic, hand-held water level meter. A mark was placed on the inner casing of each monitoring well so that all measurements were made from the same point at each location. The depth to water was measured from the top of inner casing to the nearest 0.01 feet. The measurement was repeated at least two to four times to assure that an accurate depth to water was recorded. Each well was closed and locked immediately after the measurement was collected. In addition, the water level in the Hackensack River was measured along the outside of the staff gauges from the survey mark.

2.2.6.2 *Continuous Water Level Monitoring*

The Hackensack River in the Kearny, NJ area is tidally influenced. Continuous water level monitoring was completed in eight (8) wells and in the Hackensack River to evaluate water table response to tidal fluctuations. This was conducted to determine whether there is hydrogeologic interconnection between the Fill/Peat unit, the Lower sand unit, and the Hackensack River, and if so, to determine the associated tidal reach.

The continuous water level monitoring study was conducted on 29 July 1996 through 3 August 1996 so that a number of full tidal cycles could be evaluated on the proper lunar occurrence. Care was taken to schedule the study for a period when no rain was predicted to occur, and no major weather fronts were expected to affect the area.

In order to obtain continuous detailed water level data, an In-Situ, Inc. Hermit SE-1000C series continuous data logger equipped with pressure transducer was placed in each of the following monitoring wells: 2U, 12U, 13U, and 15U, and 5L, 6L, 13L, and 15L. These locations were chosen to obtain data points in both the upper and lower ground water units at a variety of places along the Hackensack River and at variable distances away from the Hackensack River.

A depth to water measurement was collected at each well prior to installation of the pressure transducer. This allowed the data logger to record data relative to the actual depth to water in the monitoring well. As a quality control measure, the pressure transducer was submerged in the water for at least fifteen minutes prior to being connected to the data logger to assure that the transducer was thermally equilibrated with the ground water temperature. As a second quality control measure, the probe was raised one foot as measured by using a measuring tape. The data logger was then inspected to see whether a one-foot change was recorded. This step allows for any programming errors or faulty equipment to be identified prior to completing the test. The data loggers were then programmed to record at 10-minute intervals. Upon completion of the continuous water level study, all data from the Hermit continuous data loggers were directly downloaded and stored onto a computer hard-drive and back-up computer disk.

3.0 RESULTS AND DISCUSSION

This section presents an integrated discussion of the results of the FRI and previous investigations of the SCCC Site relative to the lagoon area.

3.1 GEOPHYSICS SURVEY

The Phase I geophysical survey was conducted at the Site on 10 July 1996. The objectives of the investigation were to evaluate the feasibility of detecting the topographic surface of the clay unit using surface geophysical methods. The clay unit is approximately 20 feet below the ground surface. Stratigraphically overlying the clay unit are layers of sand, peat and fill materials. The geophysical techniques evaluated during this investigation were the ground-penetrating radar (GPR) and the seismic refraction methods.

The total survey area was approximately 400 feet by 500 feet. This includes the former lagoon area and extends from the Hackensack River to west of the Conrail right-of-way. The ground surface of the investigation area is covered by a gravel/slag material. Metal and building debris were observed to be partially buried near the lagoon berm. Previous drilling at the Site had indicated that the fill layer is 8 to 10 feet thick.

3.1.1 *Ground Penetrating Radar Results*

GPR test data were collected along two traverses. The first traverse was located parallel to the south side of the lagoon, passing within 8 feet of wells 13L and 13U. The second traverse began at well 9L and extended northward, parallel to the Hackensack River, terminating at the northeast corner of the site boundary chain link fence.

Both test traverses were collected using a GSSI Subsurface Interface Radar (SIR) System 3 and a 300 MHz antenna. For initial test purposes the scan length was set to 150 nanoseconds (ns) to provide a maximum depth of penetration of approximately 21 to 30 feet (assuming an average soil round trip travel time of 5-7 ns).

GPR data along both traverses indicated that a maximum achievable depth of investigation at this site is limited to the upper 4 feet of fill material. The high electrical conductivity of the fill material saturated the radar signal near the ground surface. Because of the near-surface signal saturation, features below the fill material could not be distinguished.

3.1.2 *Seismic Refraction Results*

The test spread was initially designed to collect data with an array of 24 geophones spaced 10 feet apart. Using this geophone array, uncontrollable high frequency electrical interference was present. An unsuccessful effort was made to remove the interference by using the built-in filtering capabilities of the seismograph. Eventually, usable seismic data were obtained by reducing the overall spread length to 12 geophones spaced 10 feet apart. Electrical interference again became uncontrollable when the trigger wire was extended more than approximately 50 feet beyond either end of the geophone array. The severe interference limited the distance the source could be placed from the geophone array, thereby limiting the maximum obtainable depth of investigation.

To verify that the electrical interferences observed while collecting seismic data were most likely related to site conditions, the seismic equipment and original geophone array of 24 geophones spaced 10 feet apart was duplicated at an off-site location. During this off-site test all instrumentation operated normally and monitored noise levels were well below what would be considered acceptable amplitudes.

Upon data reduction and interpretation it became apparent that a refractor from the target clay horizon was not present in the data. The surface velocity was 3,060 ft/s which is consistent with the expected velocity of a compacted fill material or a sand unit. No velocity changes related to a subsurface interface were observed in the data. It may be possible to distinguish a higher velocity layer at a greater depth if the distance from the seismic source and the overall spread length could be increased, however high noise levels at the investigation site prevent this.

3.1.3 *Geophysics Summary Discussion*

Results from the Phase I geophysical survey indicate that it was not possible to resolve the clay horizon in the lagoon area using the GPR method or the seismic refraction method. Penetration of the GPR signal was limited to a depth of 4 feet because of the highly conductive surface fill material. The achievable depth of investigation using the seismic refraction method was limited by uncontrollable electrical interference.

Based on the results it was decided that additional GPR or seismic data would not be collected (i.e., Phase II) at the site to try to resolve the surface of the clay horizon. It is believed that neither electrical resistivity or electromagnetic methods would provide accurate depth estimates to the clay because of the very high levels of interference and the very conductive surface fill layer. Because of site conditions surrounding the lagoon area, it is unlikely that any common surface geophysical method

would be successful or cost effective for resolving the surface topography of the clay horizon.

3.2 GEOLOGY

The lithologies encountered during drilling of the 14 FRI soil borings are detailed in the logs presented in Attachment 1. The lithologies encountered from ground surface to completed boring depth are generally as follows:

- Fill material consisting of slag, gravel, sand, silt, clay, cinders, and Site debris (approximately six to eleven feet thick);
- Peat, sometimes interbedded with sand, silt, and clay (approximately two to five feet thick);
- Silty sand to Sand with trace silt (approximately three to six feet thick); and
- Clay with trace fine sand lenses (approximately 25 to 35 feet thick (estimated).

For the remainder of this report, these units will be referred to as the Fill/Peat unit, the Lower Sand unit, and the Clay unit. It should be noted that the final location of soil boring SB-10 was moved due to underground obstructions within the originally proposed location area (hence sample designation SB-10R for the relocated soil boring).

Fill material was encountered at each drilling location and is present across the entire Site. Fill material is regionally present in areas of the Hackensack River Valley, particularly in floodplain areas adjacent to principal waterways such as the Hackensack River. Surface slag fill material was placed many years ago by others along areas of low lying conditions to achieve greater topographic relief. The fill material consists of both coarse and fine grained materials and consists of clay, silt, sand, gravel, slag and cinders and was found to be of random thickness across the entire former lagoon area.

The peat/meadow mat unit which underlies the surface fill material is characterized as alluvial sedge and reed peat deposits. These deposits are typically formed in bogs along rivers and in flood plains, and are characterized by peats and associated silt, clay, and sand sediments. Based on previous subsurface data and recently collected information, the peat/meadow mat unit is present below the entire Site. Although the peat/meadow mat was not recovered in soil boring SB-7 (e.g., no sample recovery occurred at the typical depth of the peat), it is believed that the peat is present in this area. Figure 3-1 presents a subsurface structure map of the top of the peat/meadow mat unit as interpreted from the FRI soil boring and historic monitoring well logs. For ground water

interpretations, the fill unit and peat/meadow mat unit are collectively referred to as the Fill/Peat unit.

The Lower Sand unit which underlies the Fill/Peat unit is primarily silty sand to sand with trace silt. Discontinuous silt lenses are present. The coarse and fine fractions grade laterally into each other indicative of stream channel sands and adjacent floodplain sediments of a fluvial depositional environment. The unit is completely saturated as evidenced by potentiometric water level elevations above the top of the unit. The lower portion of the sand unit (i.e., just above the underlying clay unit) showed evidence of the presence of free product (i.e., DNAPL) in several areas as discussed below in Section 3.4.

The Clay unit which underlies the Lower Sand unit ranges in color from gray-brown to red-gray. The moisture of the clay visually ranges from dry to wet at the top of the unit. Blow counts (i.e., Standard Penetration Test 'N' values) greater than 15 were encountered which are indicative of a typical Pleistocene Age pre-consolidated stiff overburden clay. Thin interbeds of silt were commonly observed in the Clay unit. No free product (i.e., DNAPL) materials were observed in the clay indicating that the likely low permeability of the clay effectively impedes the vertical migration of the free product materials.

The Clay unit underlies the entire Site. Figure 3-2 presents a subsurface structure map of the top of the Clay unit as interpreted from FRI soil boring logs and historic monitoring well logs. Based on Figure 3-2, structural low spots or depressions in the clay surface exist in the south-central portion of the lagoon area in the vicinity of SB-12, and in the south western portion of the lagoon area in the vicinity of MW-4L. In no instance does there appear to be a breach through the clay underlying the Site.

Based on the meadow mat surface topography presented on Figure 3-1, and data from previous borings drilled into the lagoon during the previous RI activities at the Site, the bottom of the lagoon appears to lie within or on top of the meadow mat surface.

3.3 *HYDROGEOLOGY*

3.3.1 *Fill/Peat Unit*

The hydrogeologic interpretation of the Fill/Peat unit is based upon ground water elevation data from 9 on-site and 3 off-site shallow ground water monitoring wells (see Table 3-1). These wells have been screened across the fill unit to just above or just within the meadow mat unit. The shallow Fill/Peat unit monitoring wells range from approximately 6 to 12 feet in total depth.

Table 3-1
Ground Water Elevation Data
Standard Chlorine Chemical Company
Kearny, New Jersey

Well No.	TOC Elevation*	Date	Depth to Water, ft	Ground Water Elevation *
UPPER ZONE				
On-Site Wells				
MW-11U	7.20	7/15/96	3.34	3.86
MW-12U	8.13	7/15/96	4.47	3.66
MW-13U	11.26	7/15/96	6.32	4.94
MW-14U	8.27	7/15/96	4.33	3.94
MW-15U	6.44	7/16/96	3.13	3.31
PZ-2	7.60	7/15/96	5.86	1.74
PZ-3	6.82	7/15/96	3.62	3.20
PZ-4	7.20	7/15/96	4.90	2.30
PZ-5	10.92	7/15/96	7.83	3.09
Off-Site Wells				
121 (U)	4.77	7/15/96	0.85	3.92
120 (U)	3.26	7/15/96	0.25	3.01
119 (U)	4.20	7/15/96	0.45	3.75
LOWER ZONE				
On-Site Wells				
MW-1L	8.54	7/16/96	5.14	3.40
MW-2L	7.36	7/16/96	4.33	3.03
MW-3L	5.29	7/15/96	2.18	3.11
MW-4L	7.28	7/15/96	5.07	2.21
MW-5L	6.14	7/15/96	2.95	3.19
MW-6L	6.82	7/15/96	3.54	3.28
MW-7L	6.90	7/15/96	3.63	3.27
MW-8L	8.58	7/15/96	6.70	1.88
MW-9L	10.09	7/15/96	9.01	1.08
MW-10L	8.12	7/15/96	6.24	1.88
MW-11L	7.88	7/15/96	4.46	3.42
MW-12L	6.99	7/15/96	4.02	2.97
MW-13L	11.59	7/15/96	9.36	2.23
MW-14L	7.99	7/15/96	5.62	2.37
MW-15L	6.40	7/16/96	3.75	2.65
Off-Site Wells				
109 (L)	4.86	7/15/96	1.42	3.44
108 (L)	3.40	7/15/96	0.43	2.97
107 (L)	4.24	7/15/96	0.94	3.30

Notes:
* All elevations are in feet Mean Sea Level (MSL)
TOC = Top of Casing

3.3.1.1 *Ground Water Flow Directions*

Figure 3-3 presents the ground water elevation contour map for the Fill/Peat unit. The highest ground water elevations were measured in the central portion of the Site, suggesting the presence of a ground water mound in the vicinity of the lagoon. Ground water elevations decrease to the north, west and south away from the central portion of the former lagoon area. A slight decrease is observed to the east, although it appears that embankment materials along the river bank are impeding flow in that direction. This suggests that ground water flows radially to the north, west and south away from the water table high in the central portion of the former lagoon area. Horizontal gradients are low and range from 0.02 to 0.005. Ground water sinks appear evident at the northeast and southwest boundaries of the Site. This data indicates that the peripheral surface drainage units (i.e., the north stormsewer pipe and the southern drainage ditch) act as discharge points for the Fill/Peat unit ground water to a greater extent than the river.

3.3.2 *Lower Sand Unit*

The hydrogeology of the Lower Sand unit is based upon ground water elevation data from 15 on-site and 3 off-site lower ground water monitoring wells (see Table 3-1). The lower ground water monitoring wells are screened in the Lower Sand unit, just above or just into the top of the Clay unit. The total depths of the lower ground water wells range from approximately 16 to 22 feet.

3.3.2.1 *Ground Water Flow Directions*

Figure 3-4 presents the ground water elevation contour map for the Lower Sand unit. Based on Figure 3-4, a ground water mound is present in the northwestern portion of the lagoon area. This ground water mound is projected in a northwest to southeast orientation, with ground water flow moving radially to the east and south from the intrusion. These ground water conditions are identical to the ground water contours developed during the RI and during preparation of the FRI Work Plan. Horizontal gradients are low and range from 0.008 to 0.003. Based on the flow conditions in the Lower Sand unit, it appears that, unlike ground water flow in the Fill/Peat unit, the boundary surface drainage features (i.e., the northern stormsewer and the southern drainage ditch) do not influence flow or act as discharge points for the Lower Sand unit ground water.

3.3.3 *Vertical Gradients*

Vertical gradients were evaluated at nested well locations between the shallow Fill/Peat unit wells and the Lower Sand unit wells. In general, the ground water potentiometric surface elevations for the Fill/Peat unit are higher than those for the Lower Sand unit, suggesting a downward

vertical gradient across the majority of the lagoon area. This downward vertical gradient also suggests a component of ground water flow from the shallow Fill/Peat unit to the deeper Lower Sand unit. At the southwest and northeast corners of the lagoon area, the potentiometric surfaces of the Lower Sand unit ground water are higher than those of the upper Fill/Peat unit, indicating an upward vertical gradient, and suggesting some component of flow of water from the Lower Sand unit to the upper Fill/Peat unit in these area. It should also be noted that the potentiometric ground water surface elevations are higher than the top of the meadow mat as shown on Figure 3-1.

3.3.4 *Tidal Influences*

Continuous water level recorders were placed in monitoring wells 2U, 12U, 13U, and 15U, and 5L, 6L, 13L, and 15L to monitor potential fluctuations in ground water caused by tidal fluctuations in the Hackensack River. The continuous water level study was conducted between 29 July 1996 and 3 August 1996. Monitoring wells located adjacent to the river and at increasing distances from the river were observed to assess lateral variations of tidal influences. The magnitude of tidal fluctuations observed in the ground water monitoring wells would be expected to decrease with increasing distance from the Hackensack River.

To supplement the continuous water level study data, comprehensive synoptic water level measurements were also collected from the monitoring well network during predicted high and low tides during the study using the method described in the East Coast of North America and South America, National Oceanic and Atmospheric Administration, 1996 Tide Tables.

A summary of the tidal study, along with hydrographs generated for individual wells are presented in Attachment 3. Tidal information was obtained from the tide table for the Hackensack River at New York, NY and adjusted for Kearny Point. The adjusted tidal information is shown on Table 1 of Attachment 3. Hand measured depth to water measurements are shown on Table 2 of Attachment 3.

The hydrographs presented in Attachment 3 illustrate that the trend observed in the Hackensack River is dissimilar and does not correlate with the trends observed in the shallow ground water monitoring wells. The net rise or fall of the river in response to the tide is 5 to 6 feet. In contrast, ground water fluctuations in the shallow Fill/Peat unit monitoring wells did not show a tidal response. Some change in the shallow ground water levels was observed during the study, but these changes are suspected to be a result of other influences (e.g., surface water infiltration) The lack of tidal response in the Fill/Peat unit monitoring wells indicates a very little,

if any, hydraulic connection between the Fill/Peat unit and the Hackensack River.

Tidally influenced ground water fluctuations were not observed in most of the Lower Sand unit wells, indicating that the Lower Sand unit and the Hackensack River are generally not hydraulically connected. Similar to the Fill/Peat monitoring wells, the Lower Sand unit monitoring wells generally show only minor water level fluctuations which do not appear to be tidally related. Apparent tidally influenced ground water fluctuations of 2.5 feet and 1 foot were observed in MW-8L and MW-9L, respectively, as shown in Attachment 3. The fluctuations in MW-8L and MW-9L occur instantaneously and in phase with the Hackensack River tidal fluctuations. Because these wells are located within 40 feet of the bank of the river, the tidal affect is believed to be limited to the area immediately adjacent to the river.

The results of the FRI tidal study are generally consistent with those observed during the previous RI activities as discussed in the May 1993 Draft RI Report.

3.3.5 *Identification of Ground Water Discharge Areas and Boundaries*

Ground water flow in the Fill/Peat unit is characterized as a localized flow system which has formed as a result of the discharge boundary conditions on three sides of the Site. Although a small component of flow appears to be toward the river, the saturated area of the Fill/Peat unit has been sectioned into two main flow areas for calculation purposes based on ground water flow directions, a distinct recharge area, and distinct discharge boundaries:

- Area 1: The northeastern area adjacent to the northern property boundary through which ground water flows to the northeast; and
- Area 2: The southwestern area adjacent to the southern property boundaries through which ground water flows to the southwest.

A northwest-southeast oriented ground water divide is present in the central portion of the Site. The divide forms the boundary between Area 1 and Area 2. The ground water divide can be conceptualized as a vertical no-flow boundary through the Fill/Peat unit across which there is limited horizontal flow. Ground water in the Fill/Peat unit flows from this divide, along vertically downward flow paths, to the discharge areas along the southern and northern property boundaries (e.g., the southern drainage ditch and the northern stormwater pipe, respectively), as well as downward through the peat/meadow mat unit. Being topographically low-lying areas, the southern drainage ditch and the northern stormwater pipe suggest that topography plays a role in defining the discharge boundaries for the Fill/Peat unit.

In regards to the Lower Sand unit, the discharge boundaries are generally towards east to the Hackensack River, and to the south, as discussed above.

3.4 *RESIDUAL WASTE AND DNAPL*

As stated in Section 3.2, free-phase product (e.g., DNAPL) was encountered on the top of the Clay unit in several areas. Residual wastes associated with the former lagoon include the sludge and viscous oils in the oval shaped lagoon. The sludge is typically black and viscous, with a significant solids content. The oils, where observed, appear as free-phase liquids or DNAPL. Both the eastern and the western portion of the former lagoon were constructed adjacent to areas of coarse fill material.

3.4.1 *Chemical Composition*

The sludge materials have settled from the effluent discharged to the lagoon, and primarily consist of naphthalene-polymeric materials. The chemical composition of the sludge has been identified from the analyses of four sludge samples collected as part of the RI. These analytical data are presented in the May 1993 Draft RI Report. The most common VOCs present within the lagoon sludges include ethylbenzene, methylene chloride, and toluene. The most common SVOCs present within the lagoon sludges include 2,4-dimethyphenol, naphthalene, acenaphthene, phenol, fluorene, and phenanthrene. Other compounds may also be present in the lagoons.

Analytical data for DNAPL samples collected during preparation of the FRI Work Plan are presented on Table 2-2 above. As reported on Table 2-2, the DNAPL samples collected at the Site have specific gravities between 1.33 and 1.38, and are therefore heavier than water. In addition, the chemical composition of the sludge includes individual chemical compounds that typically behave as DNAPLs such as naphthalene and chlorinated benzenes. Although the DNAPL chemical composition reflects compounds typically associated with the lagoon sludges, some of the constituents detected in the MW-8L DNAPL sample (e.g., trichloroethylene and tetrachloroethylene) are not related to any of the documented site activities, and an off-site source of these contaminants is suspected.

3.4.2 *Lateral Extent*

During the FRI soil boring program, no sludges or viscous oils were observed in the coarse upper fill materials around the lagoon. However, elevated OVA readings of samples obtained from the fill just above the peat/meadow mat revealed potential retention of viscous oils in the interstitial pore spaces of the fill material. This retention may be occurring due to the reduced permeability of the peat layer which underlies the fill

material. Although not impermeable, the peat/meadow mat will reduce the flow of these more viscous materials. Based on these observations, it appears that these viscous oils extend beyond the maximum horizontal extent of the lagoon above the fill/peat unit.

A review of the information from drilling logs, soil borings, and monitoring wells indicates that the viscous oils are present as a free-phase at the base of the sand/top of the Clay unit. In particular, DNAPL was encountered during the FRI in borings SB-2, SB-3, SB-4, SB-10, and SB-11, and an oily sheen was observed slightly above the Clay unit in borings SB-7 and SB-9. In addition, DNAPL was detected during the FRI in some of the existing monitoring wells as presented on Table 3-2. It is likely that the oils physically migrated from the lagoon either directly to the Lower Sand unit or through the meadow mat before or after migration along the surface of the meadow mat unit. The Clay unit appears to have prevented any further vertical migration of the oils. The oils pool on top of the clay at low spots, and/or migrate horizontally along the top of the clay through the Lower Sand unit. Free product was not observed in FRI soil borings SB-1, SB-5, SB-6, SB-8, SB-12, SB-13 or SB-14.

3.5 *ANALYTICAL DATA PRESENTATION*

3.5.1 *Introduction*

Comprehensive laboratory analytical data tables for all media sampled during the FRI are presented in Attachment 4 to this report, and grain size analysis curves for the sediment samples are presented in Attachment 5. Detailed data tables comparing analytical results to potentially applicable NJDEP cleanup criteria are presented in Attachment 6, with relevant results summarized and discussed later in this Section. Full data deliverables for the FRI analytical results are presented in Attachment 7, which is bound separately.

The discussion and presentation of analytical data in this section does not include an assessment of the significance of the compound concentrations detected relative to potential impacts to human health and the environment. A qualitative risk assessment was completed to accomplish this objective, and is included as a section in the PRAP.

3.5.2 *Soil Quality*

As discussed earlier, soil samples were collected from selected soil borings completed within the lagoon area based on field screening results. One sample from the upper Fill/Peat unit and seven samples of the Lower Sand/Clay unit interface were submitted for analysis. The soil boring locations are shown on Figure 2-1, and the laboratory data tables are presented in Attachment 4. A detailed presentation of the soil sampling

Table 3-2

Summary of FRI DNAPL Measurements

Standard Chlorine Chemical Company

Kearny, New Jersey Facility

Well No.	*Date*	*DNAPL Thickness (ft)***	*Approx. Depth Well is Set into Confining Clay (ft)*
MW-4L	7/15/96	0.25	-
PZ-4D	7/15/96	1.20	-
MW-8L	7/15/96	2.26	2.4
MW-12L	7/15/96	1.34	2.1
MW-13L	7/15/96	1.91	1.5
MW-14L	7/15/96	0.90	1.5

results in comparison to the NJDEP Soil Cleanup Criteria is presented in Attachment 6 (Table 6A), with a summary of the detected compounds presented on Table 3-3.

As can be seen from Table 3-3, VOCs and SVOCs were detected in the Lower Sand unit just above the clay, with significantly lower concentrations detected in the surface sample collected from the Fill unit. The site-related compounds that were detected at concentrations exceeding the NJDEP soil cleanup criteria include 1,2,4-trichlorobenzene, 1,4-dichlorobenzene, and naphthalene. The relatively high concentrations detected in soil borings SB-3, SB-4, SB-9 and SB-10R are potential indications of DNAPL presence.

In regards to the lagoon area boundary, the northern-most sample, SB-7, exceeded the residential cleanup criteria for naphthalene, but no compounds exceeded the non-residential criteria. The other lagoon area boundary samples, SB-1 and SB-14, did not contain any constituents in excess of the NJDEP Soil Cleanup Criteria.

Tetrachloroethylene, which was detected in a previous DNAPL sample collected from near the northern Site boundary and believed to be a result of off-site influences from the adjacent Maxus Energy site, was detected at a concentration in excess of the NJDEP Soil Cleanup Criteria at SB-9. Because SB-9 is close to the northern property boundary, and because this compound is not believed to be site-related, it is again suspected to be a result of off-site impacts. It should also be noted that this compound was not detected in the surface soil sample collected from SB-9, suggesting subsurface migration from off-site to the north.

3.5.3 *Ground Water Quality*

Although ground water quality was not sampled during the FRI activities, a brief discussion of ground water quality in the lagoon area is presented to support the development of a proposed remedial action plan. A summary of the ground water quality data from the Phases I and II of the RI as compared to the NJDEP Ground Water Quality Standards for Class IIA aquifers is presented in Attachment 6 (Table 6B). A more detailed discussion of ground water sampling and ground water quality in the lagoon area is presented in the May 1993 Draft RI Report.

Although neither the Fill/Peat unit ground water nor the Lower Sand unit ground water is used as a source of drinking water at the site, NJDEP Ground Water Quality Standards for Class IIA aquifers was used for initial screening of data. As can be seen from the data presented in Attachment 6, a number of site-related compounds were detected in both the shallow and deeper ground water zones. Non-site-related compounds such as trichloroethylene and tetrachloroethylene were also detected in wells along the northern property boundary, indicating a potential off-site source.

Table 3-3
Summary of FRI Soil Sample Results
Standard Chlorine Chemical Company
Kearny, New Jersey Facility

Sample ID	NJDEP Soil Cleanup Criteria		SB03	SB04	SB09	SB09	SB14
Sample Depth (ft)			14.5-15	15-15.5	1.5-2	15-15.5	18.5-19
Lab ID#	Residential Direct Contact	NonRes Direct Contact	BRI903	BRI919	BRI920	BRI921	BRI911
Sample Date			8/5/96	8/12/96	8/12/96	8/12/96	8/7/96
Sample Time			1735	1145	1335	1450	1000
Matrix			Soil	Soil	Soil	Soil	Soil
Units	µg/kg		µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
Parameter							
VOC's (µg/kg)							
1,2,3-Trichlorobenzene	NA	NA	1,770,000	1,000,000	32.6	345,000	91.9
1,2,4-Trichlorobenzene	68,000	1,200,000	*6,540,000*	*1,870,000*	20.3	1,180,000	350
1,2,4-Trimethylbenzene	NA	NA					2.15 BMDL
1,2-Dichlorobenzene	5,100,000	10,000,000	1,080,000	1,310,000	5.98 BMDL	506,000	70.2
1,3-Dichlorobenzene	5,100,000	10,000,000	1,700,000	433,000 BMDL	3.29 BMDL	210,000	50.9
1,4-Dichlorobenzene	570,000	10,000,000	1,630,000	677,000	5.59 BMDL	257,000	53.5
Acetone	1,000,000	1,000,000					135
Butylbenzene	NA	NA		57,800 BMDL			
Chlorobenzene	37,000	680,000				42,600 BMDL	3.49 BMDL
Trichloroethylene	23,000	54,000			5.6 BMDL		
SVOC's (µg/kg)							
Naphthalene	230,000	4,200,000	1,010,000	2,400,000	191	181,000	57.2
Tetrachloroethylene	4,000	6,000				*56,900 BMDL*	

Sample ID	NJDEP Soil Cleanup Criteria		SB07	SB10R	SB01
Sample Depth (ft)			15.5-16	16-16.5	15.5-16
Lab ID#	Residential Direct Contact	NonRes Direct Contact	BRI927	BRI930	BRI931
Sample Date			08/16/96	08/16/96	08/16/96
Sample Time					
Matrix			Soil	Soil	Soil
Units	µg/kg		µg/kg	µg/kg	µg/kg
Parameter					
VOC's (µg/kg)					
1,2,3-Trichlorobenzene	NA	NA		2,140,000	
1,2,4-Trichlorobenzene	68,000	1,200,000		*2,290,000*	2 BMDL
1,2,4-Trimethylbenzene	NA	NA	65,500	60,800 BMDL	
1,2-Dichlorobenzene	5,100,000	10,000,000		2,320,000	115
1,3,5-Trimethylbenzene	NA	NA	23,900 BMDL		
1,3-Dichlorobenzene	5,100,000	10,000,000		557,000	43
1,4-Dichlorobenzene	570,000	10,000,000		1,160,000	89
m+p-Xylenes	410,000	1,000,000	44,300 BMDL		
o-Xylene	410,000	1,000,000	18,300 BMDL		
SVOC's (µg/kg)					
Naphthalene	230,000	4,200,000	1,820,000	*5,750,000*	26

Notes:
Values that are shaded are above the NJDEP Soil Cleanup Criteria for Residential Direct Contact limitations.
Values that are in bold italics, shaded and boxed are above the NJDEP Soil Cleanup Criteria for Industrial Direct Contact Limitations.
BMDL = Concentration detected below method detection limit.
NA = No standard available.

The primary site-related compounds detected in excess of the NJDEP standards include 1,2,4-trichlorobenzene, dichlorobenzene, benzene, xylenes, chlorobenzene, lead, and chromium. Exceedances were observed in both the shallow and deeper ground water flow zones.

3.5.4 *Surface Water and Sediment Quality*

Surface water and sediment quality for the Hackensack River has been evaluated by means of samples collected adjacent to the upstream and downstream surface water discharge points (i.e., the north and south outfalls, respectively), and a location adjacent to the lagoon area. The northern outfall discharge was also sampled.

3.5.4.1 *Sediment Samples*

The FRI sediment sampling locations are presented on Figure 2-1. The laboratory analytical data for the Hackensack River and North Outfall sediment samples are presented in Attachment 4. A detailed presentation of the sediment analytical data is presented in Attachment 6 (Table 6C), with a summary presented on Table 3-4. A summary of Hackensack River sediment samples collected by others during investigation of the adjacent Maxus Energy site is presented on Table 3-5. The grain size distribution curves for the sediment samples are presented in Attachment 5.

Results of the grain size analysis indicate the Hackensack Creek sediment samples to be mainly silt with varying percentages of fine sand. However, the samples obtained near the outfalls consisted primarily of fine sand with varying amounts of silt. This is to be expected as the finer fraction will tend to remain in suspension and settle slightly farther from the discharge point than the coarser sandy sediments.

3.5.4.2 *Sediment Quality*

VOCs were detected at each of the sediment sampling locations at relatively low concentrations as shown on Table 3-4. The highest concentrations were detected just downstream of the North Outfall (see Table 3-5), with concentrations decreasing in a downstream direction from the North Outfall. Discharge/loading from the former lagoon area via the shallow ground water table is unlikely based on the ground water flow contours. In addition, if discharge from the former lagoon were occurring, sediment quality would likely be worse closer to the shoreline. However, sediment quality actually improves closer to the shoreline, whereas, the opposite occurs (i.e., see the 'A' series results and the results from the Maxus Energy study).

In the absence of official sediment quality standards in New Jersey, various screening levels from other sources were compared to the sediment sample results as presented on Tables 3-4 and 3-5. In general,

Table 3-4

Summary of FRI Sediment Sample Results

Standard Chlorine Chemical Company

Kearny, New Jersey Facility

Sample ID		SED-B1	SED-B2	SED-B3	SED-A1	SED-A4	SED-A2	SED-A3	SED-C1
Lab ID#	Sediment Screening Guidelines*†	BRI933	BRI934	BRI935	BRI936	BRI937	BRI938	BRI939	BRI940
Sample Date		08/28/96	8/29/96	8/29/96	8/29/96	08/28/96	08/28/96	08/28/96	08/28/96
Matrix	*Sediment*	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
Units	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
Parameter									
VOC's (µg/kg)									
1,2,3-Trichlorobenzene	-						11.1 BMDL	18.7	
1,2,4-Trichlorobenzene	-						40.5	61.1	
1,2,4-Trimethylbenzene	-						4.51 BMDL	40.4	
1,2-Dichlorobenzene	35*	4.78 BMDL	1.95 BMDL		4.19 BMDL	7.67 BMDL	160	164	
1,3-Dichlorobenzene	-	4.45 BMDL	1.62 BMDL		18.7	31.5	145	69.6	9.11
1,4-Dichlorobenzene	110*	10.80 BMDL	3.73 BMDL	2.03 BMDL	45.4	79.1	212	160	6.17 BMDL
Benzene	-							4.68 BMDL	
Butylbenzene	-						6.52 BMDL		
Chlorobenzene	-						33.6	11.2 BMDL	
Cumene	-						5.52 BMDL	17.3	
Ethylbenzene	10*							15.7	
Methylene chloride	-				6.83 BMDL		9.3 BMDL	9.9 BMDL	8.71
Toluene	-							7.64 BMDL	
m+p-Xylenes	40*							7.79 BMDL	
p-Cymene	-						7.91 BMDL	42.8	
SVOC's (µg/kg)									
sec-Butylbenzene	-						1.84 BMDL		
Naphthalene	340/2100†	3.57 BMDL	6.88 BMDL	0.744 BMDL	2.58 BMDL	4.62 BMDL	33.5	367	

Notes:

ND = Not detected.

BMDL = Concentration detected below method detection limit

Shaded values are above the sediment standard listed.

* - Standard obtained from the Region III BTAG Screening Levels chart (8-9-95)

† - Standard obtained from the National Oceanic and Atmospheric Administration Technical Memorandum NOS OMA 52 (ER-L/ER-M Concentration)

Table 3-5

Summary of Sediment Sample Results Collected for Maxus Property Investigation

Standard Chlorine Chemical Company

Kearny, New Jersey Facility

Sample ID	Sediment Screening Guidelines*†	SED-126A	SED-126B	SED-126C
Lab ID#				
Sample Date		9/23/92	9/23/92	9/23/92
Matrix	*Sediment*	Sediment	Sediment	Sediment
Units	µg/kg	µg/kg	µg/kg	µg/kg
Parameter				
VOC's				
1,3-Dichlorobenzene	-	650		290,000
1,4-Dichlorobenzene	110*	*1,000*		*360,000*
1,2-Dichlorobenzene	35*			*280,000*
1,2,4-Trichlorobenzene	-	270		1,200,000
SVOC's				
Naphthalene	340/2100†	*480*	*7,600*	*170,000*
2-Methyl-napthalene	-		5,400	
Acenaphthylene	44*		*2,000*	
Acenaphthene	16*		*7,100*	
Phenanthrene	225/1380†	*620*	*43,000*	
Anthracene	85/960†		*21,000*	
Fluoranthene	-	2,500	35,000	
Pyrene	350/2200†	*2,200*	*46,000*	
Benzo(a)-anthracene	230/1600†	*1,500*	*26,000*	
bis(2-Ethylhexyl)-phthalate	-	10,000	15,000	
Chrysene	-	1,300		
Benzo(b)-fluoranthene	-	1,800	19,000	
Benzo(k)-fluoranthene	-	810		
Benzo(a)-pyrene	400/2500†	*1,400*	*17,000*	
Indeno(1,2,3-od)-pyrene	-	540	56,000	
Benzo(g,h,l)-perylene	-	480	4,900	
1,1,1-Trichloroethane	-			3,900
Benzene	-		410	
Chlorobenzene	-		120,000	
Pesticides/PCBs				
4,4-DDE	2.2	*22*		
4,4'-DDD	16	14		
gamma-Chlordane	-	5		
Aroclor-1254	-	210		

Notes:

ND = Not detected.

BMDL = Concentration detected below method detection limit.

Values that are in bold italics and shaded are above the listed guideline.

* - Standard obtained from the Region III BTAG Screening Levels chart (8-9-95)

† - Standard obtained from the National Oceanic and Atmospheric Administration Technical Memorandum NOS OMA 52 (ER-L/ER-M Concentration).

the results of the samples collected during the FRI contained only low levels of constituents, although some of the more conservative screening levels were exceeded in a few instances.

3.5.4.3 *Surface Water Samples*

The locations of the surface water samples are presented on Figure 2-1. The laboratory analytical data for the Hackensack River and North Outfall surface water samples are presented in Attachment 4. A detailed presentation of the surface water analytical data is presented in Attachment 6 (Table 6D), with a summary presented on Table 3-6.

3.5.4.4 *Surface Water Quality*

As can be seen from Table 3-6, only very low level concentrations of a few organic constituents were detected in the FRI surface water samples. The highest detected concentrations were found in sample SW-3 which was obtained from the north stormwater pipe outfall. ERM believes that the levels obtained from the stormwater pipe are indicative of the shallow Fill/Peat ground water unit discharging to the pipeline, and/or influences from impacted surface water runoff entering the pipeline.

To provide for initial screening of the surface water quality, the results were compared to the NJDEP Surface Water Quality Standards for the section of the Hackensack River in question. As can be seen on Table 3-6, no constituents were detected in excess of the applicable standards. The low level detections in surface water samples from the river confirm that very little, if any, hydraulic connection and discharge of ground water to the Hackensack River occurs. The low level detections further indicate that the constituents detected in the stream sediments are adsorbed to the organic sediments and are not resulting in surface water quality degradation.

3.6 *FATE AND TRANSPORT*

3.6.1 *Waste Materials*

The delineation of waste materials was completed in the eastern portion of the Site in the lagoon area.

3.6.1.1 *Sources*

Waste materials associated with the former lagoon include:

- Sludges and oils within the current extent of the lagoon; and
- Migrated oils and DNAPLs found outside the maximum extent of the lagoon.

Table 3-6

Summary of FRI Surface Water Sample Results

Standard Chlorine Chemical Company

Kearny, New Jersey Facility

Sample ID	NJDEP Surface Water Quality Standards	EB-1	SW-3	SW-2	TB-1	SW-1	SW-4
Lab ID#	"SE" Classification	BRI941	BRI942	BRI943	BRI945	BRI947	BRI948
Sample Date		08/28/96	08/28/96	08/28/96	08/28/96	08/28/96	08/28/96
Matrix	*Surface Water*	Water	Water	Water	Water	Water	Water
Units	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Parameter							
VOC's							
1,2,4-Trichlorobenzene	123						1.63 BMDL
1,2-Dichlorobenzene	16,500		6.13	1.43 BMDL		1.57 BMDL	3.14 BMDL
1,3-Dichlorobenzene	22,000		4.56 BMDL				
1,4-Dichlorobenzene	3,139		6.37	1.21 BMDL		1.47 BMDL	1.8 BMDL
Chlorobenzene	21,000		2.52 BMDL				
SVOC's							
Naphthalene	NA						3.15 BMDL

Notes:

BMDL = Concentration detected below method detection limit.

NA = No standard available.

3.6.1.2 *Fate and Transport via Wastes*

The oils and DNAPLs outside of the lagoon have migrated through the coarse fill material, and have made their way to the top of the Clay unit in portions of the lagoon area. Similar materials are expected to be present on top of the meadow mat unit in some locations. DNAPLs may also migrate via gravity flow to the structurally low areas on top of the Clay unit. It should be noted that sludge/oil has not been physically observed in the Clay. Residual DNAPLs sludges present potential continuing sources of dissolved-phase chemical compounds to ground water in the Fill/Peat unit and the Lower Sand unit.

3.6.2 *Ground Water*

Previous analytical data from the RI indicate that positively identified compounds in the Fill/Peat unit ground water primarily include VOCs and SVOCs. The highest detections in the Fill/Peat unit ground water occur in the interior portion of the Site (i.e., near the lagoon), and in structurally low areas on top of the Clay unit.

3.6.2.1 *Sources*

Probable sources of the VOCs and SVOCs include the sludges and viscous oils and sludges associated with the lagoon. These materials could act as a continuing source of dissolved-phase constituents. Analytical data also suggests that in some areas, DNAPL compounds could be a source of the chemical compounds in ground water.

A source of some VOCs detected in the Lower Sand unit (i.e., tetrachloroethene and trichloroethene) is not believed to be present on site. There is some indication that these compounds may be migrating onto the Site from the north.

3.6.2.2 *Fate and Transport via Ground Water*

The most significant migration pathways for ground water within the Fill/Peat unit are vertical migration downward into the Lower Sand unit as dissolved-phase flow, and ground water discharges by means of horizontal flow to the drainage ditch along the southern property boundary, and to the stormwater drainage pipe along the northern property boundary.

The primary migration pathway for constituents in the Lower Sand is horizontally to the south with a fractional component to the north and east. Ground water from the Lower Sand unit has a limited discharge to Hackensack River.

Overburden ground water on and downgradient of the Site is not used for drinking water, with the primary receptor of potential concern being the Hackensack River.

3.6.3 *Sediment*

Analytical data indicate that positively identified compounds in the Hackensack River sediment include some site-related SVOCs.

3.6.3.1 *Sources*

The highest detections in sediment occur downstream of the North Outfall, with concentrations decreasing in a downstream direction away from the North Outfall. Constituent concentrations generally increase away from the river bank, indicating that sediment deposition from the North Outfall is a likely source, as opposed to migration from the bank. Most of the contaminant mass in sediment is found in the sediments with the higher silt fraction. Any waste and DNAPL that may be present along the eastern property boundary is likely largely stabilized by the rip-rap along the bank of the Hackensack River.

3.6.3.2 *Fate and Transport via Sediment*

The sediment is a potential but unlikely source of continuing contaminant migration. The surface water quality results indicate that sediments do not have an adverse impact on surface water quality. In addition, it is unlikely that the sediment can be redistributed by the Hackensack River. Flow velocities sufficient to erode sediments likely do not occur due to the relatively low vertical fall and flow conditions at this point in the river that is tidally influenced, and actually changes direction at certain times. This section of the Hackensack River is likely a depositional area where sediments accumulate. If the source of chemical compounds is eliminated, natural sediments and sediments that discharge through the drainage ways such as the north stormwater pipe and south drainage ditch will continue to be deposited over and cover impacted sediments. The organic compounds sorbed onto organic sediments will likely remain immobile.

3.6.4 *Surface Water*

Low level estimated concentrations of SVOCs were detected in surface water samples obtained from the North Outfall. Only very low level estimated concentrations of SVOCs were detected in the Hackensack River surface water samples.

3.6.4.1 *Sources*

The primary source of the identified compounds in the surface water is stormwater runoff and possibly ground water discharge to the north

stormwater pipe and the southern drainage ditch. Impacted creek sediments are not a likely source. The low level detections in surface water indicate that the Site has only minor impacts to the Hackensack River and that ground water discharge from the Lower Sand unit to the river is limited. In addition, the constituents detected in sediment are likely sorbed onto the organic material and are not readily soluble to surface water. Concentrations in surface water are well below the applicable NJDEP Surface Water Quality Standards.

3.6.4.2 *Fate and Transport via Surface Water*

Given the low level detections in surface water, the limited source areas to the river, and the industrialized nature of this area, fate and transport via surface water will not significantly impact downstream receptors or be distinguishable from the impacts of other industrial facilities located along the Hackensack River.

4.0 CONCLUSIONS

The focused remedial investigations at the SCCC Site have resulted in the collection of sufficient data to formulate an accurate and thorough understanding of the former lagoon areas including: the extent and composition of residual waste materials; the geology and dynamics of the hydrogeologic system including local tidal influences and surface water/ground water interactions; the extent of chemical compounds in ground water, surface water and sediment; and the fate and transport mechanisms of chemical constituents.

4.1 GEOLOGY

- The geology underlying the Site consists of the surficial Fill, the Peat/Meadow Mat unit, the Holocene Age Sand unit, and the underlying Pleistocene Age varved clay. Fill material and the Peat/Meadow Mat is present across the Site. The Holocene sand is largely confined by the Clay unit and consists of sand with discontinuous silt lenses. The Clay unit is regionally present in the Hackensack River Valley and underlies the Site.
- There is no breach or excavation into or through the clay underlying the lagoon area. The former lagoon lies within or on top of the Fill/Peat unit.
- No sludge or staining was observed in samples obtained from the top of the Clay, which indicates that the clay provides a natural barrier and effectively limits the migration of oils/DNAPL materials.

4.2 HYDROGEOLOGY

- Ground water within the Fill/Peat unit is characterized as a local flow system which has formed as a result of the discharge boundary conditions on three sides of the Site. Ground water elevations in this unit decrease to the north, west and south away from the central portion of the lagoon area. A slight decrease is observed to the east, however, it appears that embankment materials along the river bank are impeding flow in that direction. This suggests that ground water flows radially to the north, west and south away from the water table high in the central portion of the former lagoon area.
- A ground water discharge appears evident at the northeast and southwest boundaries of the site within the Fill/Peat unit. This suggests that the peripheral surface drainage units (i.e., the north stormsewer pipe and the southern drainage ditch) act as discharge points for the Fill/Peat unit ground water to a greater extent than the river.

- One component of ground water flow in the Fill/Peat unit is vertically downward through the underlying Peat/Meadow Mat unit. The vertical component of flow in the Fill/Peat unit is somewhat limited by the estimated low hydraulic conductivity of the peat/meadow mat. Some limited seeps were observed within the Fill/Peat unit along the southern perimeter of the Site at the drainage ditch, and the existing north stormwater pipe appears to be acting as a preferential flow path, indicating a horizontal component of flow.
- The primary components of ground water flow in the Lower Sand unit are horizontally to the south and east. A ground water mound is present in the northwestern portion of the former lagoon area. This ground water intrusion is present in a northwest to southeast orientation with ground water flow moving radially to the east and south from the intrusion. These ground water conditions are identical to the ground water contours developed during the RI and preparation of the FRI Work Plan. Horizontal gradients are low and range from 0.008 to 0.003.
- Tidally influenced ground water fluctuations were not observed in the surficial Fill/Peat unit monitoring wells. This lack of tidal response indicates a very limited hydraulic connection between the Fill/Peat unit and Hackensack River, as expected. There is a small degree of ground water discharge from the Fill/Peat unit to the Hackensack River.
- Tidally influenced ground water fluctuations were generally not observed in most of the Lower Sand unit wells, except for monitoring wells MW-8L and MW-9L which are immediately adjacent to the river (i.e., within 40 feet). All other wells showed no response to the tidal fluctuation, therefore, the river tidal reach at this site is limited to only the land area immediately adjacent to the river.
- If all recharge to the Fill/Peat and Lower Sand unit were stopped by means of a cap and vertical barrier, it is estimated that ground water within these units will be isolated and ground water levels will drop, thus creating an inward hydraulic gradient which will limit potential off-site migration of ground water. This is supported by the limited tidal influence of the Hackensack River.

4.3 *DNAPL ISSUES*

- Residual waste materials consist of sludge and viscous oils associated with sludge, and residual solids. The observed migration of viscous oil and sludge suggests that related compounds behave as DNAPL. The oil and associated sludge primarily consist of the SVOCs 1,2,4-trichlorobenzene, 1,2 dichlorobenzene and naphthalene. These compounds may also behave as a DNAPL source.

- Residual waste materials related to the former lagoon is present within the fill material in areas outside of the current extent of the former lagoon. Viscous oils have migrated from the former lagoon through coarse fill material (on top of the Peat/Meadow Mat and the Clay unit) primarily to the southwest and northeast.

4.4 *GROUND WATER QUALITY*

- In general, several VOCs and SVOCs exceeded the NJDEP Ground Water Quality Standards for a Class IIA aquifer.
- Compounds detected in the Fill/Peat unit and the Lower Sand unit at concentrations indicative of DNAPL (concentrations above one percent of the solubility limit) include the SVOCs naphthalene, trichlorobenzene, and dichlorobenzene.
- Sources of some chlorinated VOCs detected in the Lower Sand unit along the northern property boundary have not been identified in on-site sources. The concentrations and distribution of these VOCs within the Lower Sand unit indicate an off-site plume north-northwest of the Site that is migrating along regional flow paths to the south-southeast.

4.5 *SURFACE WATER AND SEDIMENT QUALITY*

- The highest detections in the Hackensack River sediment occur in the area where stormwater is discharged to the river from the north stormwater pipe via the North Outfall (i.e., the area of the Maxus sediment sampling south of the north stormwater pipe).
- The majority of the contaminant mass appears to be limited to within 100 feet downstream of the north stormwater pipe discharge point (i.e., the approximate settling point for suspended solids) adjacent to the former lagoon area.
- The low level detections in the Hackensack River surface water confirms the limited hydraulic connection and discharge of ground water to the river.
- The limited compounds detected in surface water samples were all well below the applicable NJDEP Surface Water Quality Standards.

4.6 *FATE AND TRANSPORT*

- Residual sludges/oils are likely capable of being a continuing source of organic compounds to ground water within the Fill/Peat unit and Lower Sand unit. DNAPL in the form of residual sludges/oils has been found in association with the lagoon. Sludges/oils which have migrated away from the lagoon represent potential contaminant sources.

- Within the Fill/Peat unit, ground water discharge by means of horizontal flow occurs to the drainage ditch along the southern property boundary, and to the stormwater pipe along the northern property boundary. A downward vertical gradient also suggests some downward component of flow to the Lower Sand unit.
- The primary migration pathway for constituents in the Lower Sand unit ground water is horizontally to the south and east.
- Sludge/oils along the bank of the Hackensack River are not likely to be a source of impacts to the river sediment as the major loading to the river apparently occurs via the northern stormwater pipe. Hackensack River sediments are not a likely source of contamination to surface water or downgradient sediments. Constituents in the river sediment are sorbed onto the organic sediments and will likely remain immobile.
- Given the industrialized nature of the area, impacts will likely not be distinguishable from the impacts of other facilities located along the Hackensack River.

4.7 *RECOMMENDATIONS*

The focused remedial investigation activities at the SCCC Site have led to an accurate and thorough understanding of the lagoon area in the eastern portion of the Site. The lagoon area is considered to be the Site's primary area of concern based on existing data. This comprehensive understanding is sufficient to support the development of an appropriate remedial measure for the lagoon area. It is therefore recommended that the Focused Remedial Investigation (FRI) phase for the lagoon area be terminated.

Attachment 1
FRI Soil Boring Logs

ERM
300 Phillips Boulevard, Suite 200
Ewing, New Jersey 08618

nt: Standard Chlorine Chemical Company, Inc.		WO#: L7905.03.01	Boring/Well: SB-1
roject: Focused Remedial Investigation			
Date Started: 8/16/96	Date Completed: 8/16/96	Screen: NA	From: -To:
Logged By: F. Nemec	Checked By:	Pack: NA	From: -To:
Drilling Co.: JCA	Driller: S. Berger	Seal: NA	From: -To:
Method: Mud Rotary	Equipment: ATV Portable Rig	Grout: NA	From: -To:
Boring Depth: 18 ft.	Ground Surface Elevation: 4.82 ft.	Inner Casing: NA	
Initial GW Level: 2.0 ft.	GW Level: NA Time/Date NA	Outer Casing/Stick Up: NA	

Depth	Sample	Recovery	Blow Count	Headspace ppm	Lithology	Description	Remarks	Well Construction
0						0-2 ft. - 0-6" - asphalt; 6"-2' - gray medium to coarse angular gravel, some fine to coarse sand, moist.		NA
2		4"	1,2,2,2	2		2-4 ft. - Black cinders, some fine to coarse sand, some fine to coarse gravel, wet throughout.		
4		2"	2,1,1,1	1		4-6 ft. - Same as previous, wet.		
6		4"	2,2,10,2	1		6-8 ft. - Same as previous with occasional wood pieces, wet.		
8		4"	4,4,3,3			8-10 ft. - Dark brown organic clayey silt to 9 ft; Dark brown meadow mat, wet from 9-10 ft.		
10		6"	4,4,3,4			10-12 ft. - Brown meadow mat and dark gray organic clay, wet.		
12								

ERM
300 Phillips Boulevard, Suite 200
Ewing, New Jersey 08618

nt: Standard Chlorine Chemical Company, Inc.		WO#: L7905.03.01	Boring/Well: SB-1
roject: Focused Remedial Investigation			
Date Started: 8/16/96	Date Completed: 8/16/96	Screen: NA	From: -To:
Logged By: F. Nemec	Checked By:	Pack: NA	From: -To:
Drilling Co.: JCA	Driller: S. Berger	Seal: NA	From: -To:
Method: Mud Rotary	Equipment: ATV Portable Rig	Grout: NA	From: -To:
Boring Depth: 18 ft.	Ground Surface Elevation: 4. 82 ft	Inner Casing: NA	
Initial GW Level: 2.0 ft.	GW Level: NA Time/Date NA	Outer Casing/Stick Up: NA	

Depth	Sample	Recovery	Blow Count	Headspace ppm	Lithology	Description	Remarks	Well Construction
12		10"	5,11,12,12	0		12-14 ft. - Medium to dark gray fine to medium sand, fairly well sorted, trace fine subangular gravel, wet.		NA
14		10"	10,12,13,18	0		14-16 ft. - Medium gray fine to medium sand, grading finer with depth, trace fine subangular gravel, wet.		
16		16"	6,7,6,6	0		16-18 ft. - Reddish-gray varved clayey silt, occasional lenses of fine sand, moist, stiff.		
18								
20								
22								
24								

ERM
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Client: Standard Chlorine Chemical Company, Inc.		WO#: L7905.03.01	Boring/Well: SB-2
Project: Focused Remedial Investigation			
Date Started: 8/6/96	Date Completed: 8/6/96	Screen: NA	From: -To:
Logged By: F. Nemec	Checked By:	Pack: NA	From: -To:
Drilling Co.: JCA	Driller: S. Berger	Seal: NA	From: -To:
Method: Mud Rotary	Equipment: CME Truck Rig	Grout: NA	From: -To:
Boring Depth: 18 ft.	Ground Surface Elevation: 4.30 ft	Inner Casing: NA	
Initial GW Level: 4.0 ft.	GW Level: NA Time/Date NA	Outer Casing/Stick Up: NA	

Depth	Sample	Recovery	Blow Count	Headspace ppm	Lithology	Description	Remarks	Well Construction
0		10"	4,10,8,9	4		0-2 ft. - Reddish brown fine to medium sand and clayey silt fill, frequent rounded and angular gravel, wet to 1.5 ft. 1.5-2 ft. Black medium to coarse sand and cinder fill, very moist.		NA
2		0"	3,6,8,9			2-4 ft. - No recovery.		
4		12"	8,8,9,11	10		4-6 ft. - Black clayey silt fill, some medium to coarse sand, little coarse gravel, wet, sheen on soil.		
6		20"	4,10,11,12	12		6-8 ft. - Same as previous, wood timber piece present at tip of spoon (8 ft.).		
8		0"	3,2,2,3			8-10 ft. - No recovery; based on blow counts, probable meadow mat.		
10		24"	7,8,8,7	2		10-12 ft. - Dark brown and black meadow mat and organic silt, very moist to wet. 11.5-12 ft. Light gray-brown fine sand, some silt, very moist to wet.		
12								

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300 Phillips Boulevard, Suite 200
Ewing, New Jersey 08618

Client: Standard Chlorine Chemical Company, Inc.		WO#: L7905.03.01	Boring/Well: SB-2
Project: Focused Remedial Investigation			
Date Started: 8/6/96	Date Completed: 8/6/96	Screen: NA	From: -To:
Logged By: F. Nemec	Checked By:	Pack: NA	From: -To:
Drilling Co.: JCA	Driller: S. Berger	Seal: NA	From: -To:
Method: Mud Rotary	Equipment: CME Truck Rig	Grout: NA	From: -To:
Boring Depth: 18 ft.	Ground Surface Elevation: 4.30 ft.	Inner Casing: NA	
Initial GW Level: 4.0 ft.	GW Level: NA Time/Date NA	Outer Casing/Stick Up: NA	

Depth	Sample	Recovery	Blow Count	Headspace ppm	Lithology	Description	Remarks	Well Construction
2		14"	17,18,26,30	1		12-14 ft. - Light gray fine to medium fairly well sorted sand, trace silt, wet.		NA
4		16"	12,15,16,18	2 15		14-16 ft. - Light gray same as previous with increasing silt content (30% by 15.5 ft.). Sand is saturated with dark brown DNAPL from 15.5-16 ft.		
6		16"	9,8,10,12	5		16-18 ft. - Medium brown-gray clayey silt/silty clay, occasional lenses of fine sand throughout, moist.		
8								
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ERM

: Standard Chlorine Chemical Company, Inc.		WO#: L7905.03.01	Boring/Well: SB-3
oject: Focused Remedial Investigation			
ate Started: 8/5/96	Date Completed: 8/5/96	Screen: NA	From: -To:
ogged By: F. Nemec	Checked By:	Pack: NA	From: -To:
rilling Co.: JCA	Driller: S. Berger	Seal: NA	From: -To:
ethod: Mud Rotary	Equipment: CME Truck Rig	Grout: NA	From: -To:
oring Depth: 18 ft.	Ground Surface Elevation: 4.63 ft.	Inner Casing: NA	
itial GW Level: 4.0 ft.	GW Level: NA Time/Date NA	Outer Casing/Stick Up: NA	

Depth	Sample	Recovery	Blow Count	Headspace ppm	Lithology	Description	Remarks	Well Construction
		24"	6,8,12,10	0		0-2 ft. - 0 to 0.67 ft. Red-brown medium to coarse sand, some silt, some fine to coarse angular gravel, wet. 0.67 to 1.3 ft. Black coarse sand and cinders, very moist. 1.3 to 2 ft. Light gray-green silt, some fine sand, moist.		NA
		24"	6,8,10,10	2		2-4 ft. - Gray-green and red fine to medium sand, silt and fine rounded gravel fill, moist.		
		24"	3,6,8,8	3		4-6 ft. - Dark gray-black fine to medium sand and cinder fill, wet to 5 ft. 5-6 ft. Light gray-green silt, some fine sand, moist.		
		6"	2,1,1,1			6-8 ft. - Brown meadow mat, moist.		
		24"	2,1,1,1			8-10 ft. - Same as previous, moist.		
0		6"	2,2,2,2	1		10-12 ft. - Light gray fine sand, some clayey silt, moist.		
2								

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ERM

nt: Standard Chlorine Chemical Company, Inc.		WO#: L7905.03.01	Boring/Well: SB-3
roject: Focused Remedial Investigation			
Date Started: 8/5/96	Date Completed: 8/5/96	Screen: NA	From: -To:
Logged By: F. Nemec	Checked By:	Pack: NA	From: -To:
Drilling Co.: JCA	Driller: S. Berger	Seal: NA	From: -To:
Method: Mud Rotary	Equipment: CME Truck Rig	Grout: NA	From: -To:
Boring Depth: 18 ft.	Ground Surface Elevation: 4.63 ft.	Inner Casing: NA	
Initial GW Level: 4.0 ft.	GW Level: NA Time/Date NA	Outer Casing/Stick Up: NA	

Depth	Sample	Recovery	Blow Count	Headspace ppm	Lithology	Description	Remarks	Well Construction
12		16"	16,20,16,19	15		12-14 ft. - Medium brown fine to medium sand, trace silt, very moist to wet, distinct odor.		NA
14		20"	13,16,18,20	2		14-16 ft. - Medium reddish-gray and brown fine to medium sand, some silt, saturated with DNAPL, grading to clayey silt by 15.5 ft., with frequent fine sand lenses. The lenses of sand are black and saturated with DNAPL to 16 ft.		
16		20"	12,13,15,19	2		16-18 ft. - Medium gray clayey silt/silty clay, trace fine sand lenses, odor, but no DNAPL observed.		
18								
20								
22								
24								

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nt: Standard Chlorine Chemical Company, Inc.		WO#: L7905.03.01	Boring/Well: SB-4
roject: Focused Remedial Investigation			
Date Started: 8/12/96	Date Completed: 8/12/96	Screen: NA	From: -To:
Logged By: F. Nemec	Checked By:	Pack: NA	From: -To:
Drilling Co.: JCA	Driller: S. Berger	Seal: NA	From: -To:
Method: Mud Rotary	Equipment: CME Truck Rig	Grout: NA	From: -To:
Boring Depth: 16 ft.	Ground Surface Elevation: 4.20 ft.	Inner Casing: NA	
Initial GW Level: 4.0 ft.	GW Level: NA Time/Date NA	Outer Casing/Stick Up: NA	

Depth	Sample	Recovery	Blow Count	Headspace ppm	Lithology	Description	Remarks	Well Construction
0		12"	5,5,13,15	0		0-2 ft. - Medium gray-brown to reddish-brown to black fine to coarse sand fill, some fine rounded gravel, some silt, moist.		NA
2		20"	5,5,5,5	0.5		2-4 ft. - Medium to dark reddish-brown and gray fine to coarse sand, fine rounded and angular gravel, some silt, moist, wet at 4.0 ft.		
4		24"	2,3,5,6	1		4-6 ft. - Same as previous, wet.		
6		4"	2,1,1,2			6-8 ft. - Dark brown meadow mat, some organic silt, moist.		
8		14"	2,2,3,8			8-10 ft. - Same as above to 9.5 ft.; 9.5-10 ft. Olive-green fine sand, some silt, wet.		
10		16"	5,5,6,6	3		10-12 ft. - Same as above to 11 ft.; 11-12 ft. Dark gray to black fine to medium sand, little silt, wet.		
12								

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ERM

Client: Standard Chlorine Chemical Company, Inc.		WO#: L7905.03.01	Boring/Well: SB-4
Project: Focused Remedial Investigation			
Date Started: 8/12/96	Date Completed: 8/12/96	Screen: NA	From: -To:
Logged By: F. Nemec	Checked By:	Pack: NA	From: -To:
Drilling Co.: JCA	Driller: S. Berger	Seal: NA	From: -To:
Method: Mud Rotary	Equipment: CME Truck Rig	Grout: NA	From: -To:
Boring Depth: 16 ft.	Ground Surface Elevation: 4.20 ft.	Inner Casing: NA	
Initial GW Level: 4.0 ft.	GW Level: NA Time/Date NA	Outer Casing/Stick Up: NA	

Depth	Sample	Recovery	Blow Count	Headspace ppm	Lithology	Description	Remarks	Well Construction
12		10"	8,9,12,15	5		12-14 ft. - Dark gray to black fine to medium sand, little/some silt, wet, grading siltier with depth.		NA
14		18"	8,12,14,16	25		14-16 ft. - Same as above to 14.5 ft.; 14.5-15.5 ft. Medium brown fine to medium sand, trace silt, wet, saturated with DNAPL from 15-15.5 ft.; 15.5-16 ft. Medium gray silty clay with occasional fine sand lenses, wet.		
16								
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22								
24								

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Client: Standard Chlorine Chemical Company, Inc.		WO#: L7905.03.01	Boring/Well: SB-5
Project: Focused Remedial Investigation			
Date Started: 8/6/96	Date Completed: 8/6/96	Screen: NA	From: -To:
Logged By: F. Nemec	Checked By:	Pack: NA	From: -To:
Drilling Co.: JCA	Driller: S. Berger	Seal: NA	From: -To:
Method: Mud Rotary	Equipment: CME Truck Rig	Grout: NA	From: -To:
Boring Depth: 20 ft.	Ground Surface Elevation: 6.40	Inner Casing: NA	
Initial GW Level: 7.5 ft.	GW Level: NA Time/Date NA	Outer Casing/Stick Up: NA	

Depth	Sample	Recovery	Blow Count	Headspace ppm	Lithology	Description	Remarks	Well Construction
0		20"	5,7,6,6	5		0-2 ft. - Medium to dark brown fine to coarse sand fill, some silt, some angular gravel, occasional cinders, moist.		NA
2		18"	6,6,5,5	4		2-4 ft. - Medium gray and green medium to coarse sand and clayey silt fill, trace fine to coarse gravel, moist to very moist.		
4		20"	3,3,9,8	5		4-6 ft. - Same as previous, moist.		
6		24"	9,8,10,12	5		6-8 ft. - Same as previous, wet at 7.5 ft.		
8		24"	3,3,4,3	4		8-10 ft. - Same as previous to 9.5 ft. 9.5-10 ft. Dark brown-black meadow mat and organic silt, moist.		
10		10"	3,3,2,3			10-12 ft. - Dark brown-black meadow mat and organic silt, moist.		
12								

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ERM

nt: Standard Chlorine Chemical Company, Inc.		WO#: L7905.03.01	Boring/Well: SB-5
roject: Focused Remedial Investigation			
Date Started: 8/6/96	Date Completed: 8/6/96	Screen: NA	From: -To:
Logged By: F. Nemec	Checked By:	Pack: NA	From: -To:
Drilling Co.: JCA	Driller: S. Berger	Seal: NA	From: -To:
Method: Mud Rotary	Equipment: CME Truck Rig	Grout: NA	From: -To:
Boring Depth: 20 ft.	Ground Surface Elevation: 6.40	Inner Casing: NA	
Initial GW Level: 7.5 ft.	GW Level: NA Time/Date NA	Outer Casing/Stick Up: NA	

Depth	Sample	Recovery	Blow Count	Headspace ppm	Lithology	Description	Remarks	Well Construction
12		22"	4,3,8,9	3		12-14 ft. - Medium to light gray fine sand, trace silt, wet at 13 ft.		NA
14		16"	17,26,29,21	2		14-16 ft. - Light gray, well sorted, fine to coarse sand, trace fine rounded gravel, trace silt, wet.		
16		8"	26,27,29,21	4		16-18 ft. - Light gray fairly well sorted fine to medium sand, little/some silt, grading finder with depth, wet.		
18		18"	8,10,9,12	3		18-20 ft. - Light reddish-gray clayey silt, occasional fine sand lenses, moist to very moist.		
20								
22								
24								

ERM
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Client: Standard Chlorine Chemical Company, Inc.		WO#: L7905.03.01	Boring/Well: SB-6
Project: Focused Remedial Investigation			
Date Started: 8/7/96	Date Completed: 8/7/96	Screen: NA	From: -To:
Logged By: F. Nemec	Checked By:	Pack: NA	From: -To:
Drilling Co.: JCA	Driller: S. Berger	Seal: NA	From: -To:
Method: Mud Rotary	Equipment: CME Truck Rig	Grout: NA	From: -To:
Boring Depth: 22 ft.	Ground Surface Elevation: 7.99 ft.	Inner Casing: NA	
Initial GW Level: 6.0 ft.	GW Level: NA Time/Date NA	Outer Casing/Stick Up: NA	

Depth	Sample	Recovery	Blow Count	Headspace ppm	Lithology	Description	Remarks	Well Construction
0		10"	6,2,2,2	0		0-2 ft. - Orange-brown fine to medium sand fill, some silt, little fine angular gravel, damp; 1-2 ft. Dark gray clayey silt and medium to coarse sand, little fine to coarse gravel, moist.		NA
2		20"	3,4,3,3	0		2-4 ft. - Dark gray clayey silt and medium to coarse sand fill, little fine to coarse gravel with yellow and green rock pieces, moist.		
4		24"	3,6,8,9	0		4-6 ft. - Same as previous, very moist.		
6		24"	3,4,5,5	1		6-8 ft. - Same as previous, wet at 6 ft.		
8		18"	3,3,10,10	0		8-10 ft. - Same as previous, wet.		
10		4"	3,3,2,2			10-12 ft. - Dark brown and black peat and organic silt, moist.		
12								

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300 Phillips Boulevard, Suite 200
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Client: Standard Chlorine Chemical Company, Inc.		WO#: L7905.03.01	Boring/Well: SB-6
Project: Focused Remedial Investigation			
Date Started: 8/7/96	Date Completed: 8/7/96	Screen: NA	From: -To:
Logged By: F. Nemec	Checked By:	Pack: NA	From: -To:
Drilling Co.: JCA	Driller: S. Berger	Seal: NA	From: -To:
Method: Mud Rotary	Equipment: CME Truck Rig	Grout: NA	From: -To:
Boring Depth: 22 ft.	Ground Surface Elevation: 7.99 ft.	Inner Casing: NA	
Initial GW Level: 6.0 ft.	GW Level: NA Time/Date NA	Outer Casing/Stick Up: NA	

Depth	Sample	Recovery	Blow Count	Headspace ppm	Lithology	Description	Remarks	Well Construction
12		2"	1,1,1,1			12-14 ft. - Dark brown and black peat and organic silt, wet.		NA
14		18"	5,5,9,10	2		14-16 ft. - Same as previous to 15 ft.; 15-16 ft. Light gray-brown fine sand and silt, grading coarser with depth, wet.		
16		16"	9,10,14,18	0		16-18 ft. - Medium reddish-gray well sorted fine to coarse sand, trace silt, wet.		
18		10"	21,18,16,14	0		18-20 ft. - Medium yellow-brown fine to medium sand, trace fine rounded gravel, trace silt, wet.		
20		14"	6,6,5,7	0		20-22 ft. - Medium brown-gray stiff silty clay, trace lenses of fine sand, very moist to wet.		
22								
24								

ERM
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Client: Standard Chlorine Chemical Company, Inc.		WO#: L7905.03.01	Boring/Well: SB-7
Project: Focused Remedial Investigation			
Date Started: 8/16/96	Date Completed: 8/16/96	Screen: NA	From: -To:
Logged By: F. Nemec	Checked By:	Pack: NA	From: -To:
Drilling Co.: JCA	Driller: S. Berger	Seal: NA	From: -To:
Method: Mud Rotary	Equipment: ATV Portable Rig	Grout: NA	From: -To:
Boring Depth: 18 ft.	Ground Surface Elevation: 4.17 ft.	Inner Casing: NA	
Initial GW Level: 3.0 ft.	GW Level: NA Time/Date NA	Outer Casing/Stick Up: NA	

Depth	Sample	Recovery	Blow Count	Headspace ppm	Lithology	Description	Remarks	Well Construction
0		10"	3,2,2,2	3		0-2 ft. - Medium reddish-brown silt and fine sand fill, frequent fine to coarse angular gravel, moist.		NA
2		16"	10,6,5,4	3 6		2-4 ft. - Same as previous to 3 ft.; 3-4 ft. Black fine to coarse sand fill, freq. cinders, some fine gravel, wet, with occasional fine brick fragments.		
4		2"	3,2,2,2	10		4-6 ft. - Black cinders, wet, distinct odor.		
6		18"	3,2,3,6	7		6-8 ft. - Dark gray to black fine sand and silt fill, loose, wet and saturated with product (oily sheen), low odor.		
8		14"	6,5,6,8	5		8-10 ft. - Medium to dark gray silt and fine sand fill, trace fine gravel/cinders, wet, oily sheen becoming less evident with depth within silt.		
10		0"	3,1,2,3			10-12 ft. - No recovery.		
12								

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Client: Standard Chlorine Chemical Company, Inc.		WO#: L7905.03.01	Boring/Well: SB-7
Project: Focused Remedial Investigation			
Date Started: 8/16/96	Date Completed: 8/16/96	Screen: NA	From: -To:
Logged By: F. Nemec	Checked By:	Pack: NA	From: -To:
Drilling Co.: JCA	Driller: S. Berger	Seal: NA	From: -To:
Method: Mud Rotary	Equipment: ATV Portable Rig	Grout: NA	From: -To:
Boring Depth: 18 ft.	Ground Surface Elevation: 4.17 ft.	Inner Casing: NA	
Initial GW Level: 3.0 ft.	GW Level: NA Time/Date NA	Outer Casing/Stick Up: NA	

Depth	Sample	Recovery	Blow Count	Headspace ppm	Lithology	Description	Remarks	Well Construction
12		10"	2,4,4,3	7		12-14 ft. - Dark gray mucky, loose fine sand and silt, wet, saturated with an oily sheen.		NA
14		12"	15,15,15,16	8		14-16 ft. - Medium brown fine to medium sand, trace silt, wet with an oily sheen.		
16		6"	6,9,8,10	4		16-18 ft. - Medium reddish-gray clayey silt, occasional fine sand lenses, moist.		
18								
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24								

ERM
300 Phillips Boulevard, Suite 200
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Client: Standard Chlorine Chemical Company, Inc.		WO#: L7905.03.01	Boring/Well: SB-8
Project: Focused Remedial Investigation			
Date Started: 8/5/96	Date Completed: 8/5/96	Screen: NA	From: -To:
Logged By: F. Nemec	Checked By:	Pack: NA	From: -To:
Drilling Co.: JCA	Driller: S. Berger	Seal: NA	From: -To:
Method: Mud Rotary	Equipment: CME Rig	Grout: NA	From: -To:
Boring Depth: 18 ft.	Ground Surface Elevation: 4.53 ft.	Inner Casing: NA	
Initial GW Level: 2.0 ft.	GW Level: NA Time/Date NA	Outer Casing/Stick Up: NA	

Depth	Sample	Recovery	Blow Count	Headspace ppm	Lithology	Description	Remarks	Well Construction
0		14"	12,14,21,22	3		0-2 ft. - Brown-red medium to coarse sand fill, some fine angular gravel, moist, to 1.0 ft.; 1.0-2.0 ft. Black fine to coarse sand and cinder fill, some fine angular and rounded gravel, very moist, dense.		NA
2		6"	10,12,14,14	7		2-4 ft. - Black medium to coarse sand and fine angular gravel fill, wet, dense.		
4		6"	6,10,12,20	5		4-6 ft. - Same as previous, wet.		
6		14"	4,2,2,2	9		6-8 ft. - Medium greenish-gray clayey silt, some fine sand, occasional black cinder pieces, wet, to 7.5 ft.; 7.5-8 ft. Brown meadow mat.		
8		0"	6,8,8,9			8-10 ft. - No recovery.		
10		10"	3,4,7,9	7		10-12 ft. - Dark brown/black meadow mat and organic silt, wet.		
12								

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Client: Standard Chlorine Chemical Company, Inc.		WO#: L7905.03.01	Boring/Well: SB-8
Project: Focused Remedial Investigation			
Date Started: 8/5/96	Date Completed: 8/5/96	Screen: NA	From: -To:
Logged By: F. Nemec	Checked By:	Pack: NA	From: -To:
Drilling Co.: JCA	Driller: S. Berger	Seal: NA	From: -To:
Method: Mud Rotary	Equipment: CME Rig	Grout: NA	From: -To:
Boring Depth: 18 ft.	Ground Surface Elevation: 4.53 ft.	Inner Casing: NA	
Initial GW Level: 2.0 ft.	GW Level: NA Time/Date NA	Outer Casing/Stick Up: NA	

Depth	Sample	Recovery	Blow Count	Headspace ppm	Lithology	Description	Remarks	Well Construction
12		6"	4,4,5,8	15		12-14 ft. - Dark gray fine sand, poorly sorted, trace/little silt, wet, slight sheen, odor.		NA
14		14"	16,17,22,18	4		14-16 ft. - Light to medium brown-gray fine sand, poorly sorted, wet, trace silt to 15 ft.; 15-16 ft. Medium reddish-gray clayey silt, varved, with trace fine sand lenses, moist.		
16		16"	12,12,12,9	2		16-18 ft. - Medium brown-gray silty clay (increasing clay content with depth), stiff, moist, trace fine sand lenses.		
18								
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ERM

t: Standard Chlorine Chemical Company, Inc.		WO#: L7905.03.01	Boring/Well: SB-9
Project: Focused Remedial Investigation			
Date Started: 8/12/96	Date Completed: 8/12/96	Screen: NA	From: To:
Logged By: F. Nemec	Checked By:	Pack: NA	From: To:
Drilling Co.: JCA	Driller: S. Berger	Seal: NA	From: To:
Method: Mud Rotary	Equipment: ATV Portable Rig	Grout: NA	From: To:
Boring Depth: 16 ft.	Ground Surface Elevation: 4.50 ft.	Inner Casing: NA	
Initial GW Level: 2.0 ft.	GW Level: NA Time/Date NA	Outer Casing/Stick Up: NA	

Depth	Sample	Recovery	Blow Count	Headspace ppm	Lithology	Description	Remarks	Well Construction
0		18"	3,4,5,5	30		0-2 ft. - Red-brown clayey silt fill, some fine to coarse sand, occasional fine to coarse angular gravel, moist to very moist, very strong solvent odor.		NA
2		18"	4,8,9,9	100		2-4 ft. - Same as previous, wet to 3 ft.; 3-4 ft. Dark green-gray and black fine to coarse sand and cinders, some coarse gravel, wet, very strong solvent odor.		
4		14"	5,5,6,7	150		4-6 ft. - Green-gray silt, fine sand, fine gravel and cinder fill, wet to 5.5 ft., with a strong solvent odor, becoming moist from 5.5-6 ft. with increasing silt/clay content.		
6		0"	2,2,2,2			6-8 ft. - No recovery.		
8		12"	1,1,1,1	20		8-10 ft. - Dark brown meadow mat, some organic silt, slight solvent odor, moist.		
10		18"	5,5,4,4	1		10-12 ft. - Medium gray fine sand and clayey silt, very moist to wet from 10 to11.5 ft.; 11.5-12 ft. Gray fine to medium sand, little silt, wet.		
12								

300 Phillips Boulevard, Suite 200
Ewing, New Jersey 08618

ERM

Client: Standard Chlorine Chemical Company, Inc.		WO#: L7905.03.01	Boring/Well: SB-9
Project: Focused Remedial Investigation			
Date Started: 8/12/96	Date Completed: 8/12/96	Screen: NA	From: -To:
Logged By: F. Nemec	Checked By:	Pack: NA	From: -To:
Drilling Co.: JCA	Driller: S. Berger	Seal: NA	From: -To:
Method: Mud Rotary	Equipment: ATV Portable Rig	Grout: NA	From: -To:
Boring Depth: 16 ft.	Ground Surface Elevation: NA	Inner Casing: NA	
Initial GW Level: 2.0 ft.	GW Level: NA Time/Date NA	Outer Casing/Stick Up: NA	

Depth	Sample	Recovery	Blow Count	Headspace ppm	Lithology	Description	Remarks	Well Construction
12		18"	4,6,12,14	1.5		12-14 ft. - Gray with red streaking, fine to medium sand, little silt, wet.		NA
14		16"	12,13,15,18	10		14-16 ft. - Medium gray intervals of wet fine to medium sand and clayey silt grading to medium gray clayey silt/silty clay with fine sand lenses. Sand intervals from 14-15.5 ft. contain a sheen on water.		
16								
18								
20								
22								
24								

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Ewing, New Jersey 08618

ERM

t: Standard Chlorine Chemical Company, Inc.		WO#: L7905.03.01	Boring/Well: SB-10
roject: Focused Remedial Investigation			
Date Started: 8/16/96	Date Completed: 8/16/96	Screen: NA	From: -To:
.ogged By: F. Nemec	Checked By:	Pack: NA	From: -To:
Drilling Co.: JCA	Driller: S. Berger	Seal: NA	From: -To:
Method: Mud Rotary	Equipment: ATV Portable Rig	Grout: NA	From: -To:
Boring Depth: 18 ft.	Ground Surface Elevation: 4.19 ft.	Inner Casing: NA	
nitial GW Level: 3.5 ft.	GW Level: NA Time/Date NA	Outer Casing/Stick Up: NA	

Depth	Sample	Recovery	Blow Count	Headspace ppm	Lithology	Description	Remarks	Well Construction
0		16"	11,21,32,28	20		0-2 ft. - Brown clayey silt fill, with fine to coarse sand, and fine to coarse rounded gravel, wet, to 0.5 ft. 0.5-2 ft. Black fine to coarse sand, cinders, some fine to coarse angular gravel, very moist with a pungent odor, bricks are located at 2 ft.		NA
2		20"	14,17,15,13	3		2-4 ft. - Black cinder fill, some fine to coarse sand, wet with a sheen beginning at 3.5 ft.		
4		14"	7,6,8,4	3		4-6 ft. - Same as previous, wet with a sheen.		
6		6"	4,3,3,3	2		6-8 ft. - Same as previous, wet with a sheen.		
8		0"	1,1,1,1			8-10 ft. - No recovery.		
10		14"	1,1,1,2			10-12 ft. - Brown meadow mat, some organic silt, very moist to 11.5 ft.; 11.5-12 ft. Medium gray fine sand, some silt, wet.		
12								

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Ewing, New Jersey 08618

ERM

t: Standard Chlorine Chemical Company, Inc.		WO#: L7905.03.01	Boring/Well: SB-10
roject: Focused Remedial Investigation			
ate Started: 8/16/96	Date Completed: 8/16/96	Screen: NA	From: -To:
ogged By: F. Nemec	Checked By:	Pack: NA	From: -To:
rilling Co.: JCA	Driller: S. Berger	Seal: NA	From: -To:
ethod: Mud Rotary	Equipment: ATV Portable Rig	Grout: NA	From: -To:
oring Depth: 18 ft.	Ground Surface Elevation: 4.19 ft.	Inner Casing: NA	
itial GW Level: 3.5 ft.	GW Level: NA Time/Date NA	Outer Casing/Stick Up: NA	

Depth	Sample	Recovery	Blow Count	Headspace ppm	Lithology	Description	Remarks	Well Construction
2		14"	7,7,8,8	15		12-14 ft. - Dark gray and black fine sand, some silt, wet, fingers of DNAPL observed throughout sample.		NA
4		20"	6,6,7,7	15		14-16 ft. - Same as previous, DNAPL concentrations increasing with depth. Beginning at 15.5 ft., sand is becoming medium brown, coarser, with significantly less DNAPL observed.		
16		10"	9,11,13,13	20		16-18 ft. - Medium brown fine to medium sand, wet, continual saturation with DNAPL to 16.5 ft.; 16.5-18 ft. Medium gray silt, trace clay, trace fine sand (lenses), dry to damp.		
18								
20								
22								
24								

Table 1
Tidal Data for Hackensack River

	Differences				Ranges		Mean Tide Level
	Time, mins		Height,ft				
	High	Low	High	Low	Mean	Spring	
Kearny Point	8	25	1.14	1.14	5.2	6.29	2.85

		Adjusted	
Time	Height, ft.	Time, min.	Height, ft.
7/29/96 0:58	-0.5	7/29/96 1:23	0.64
7/29/96 6:50	5.1	7/29/96 6:58	6.24
7/29/96 13:09	-0.3	7/29/96 13:34	0.84
7/29/96 19:11	6.2	7/29/96 19:19	7.34
7/30/96 1:50	-0.8	7/30/96 2:15	0.34
7/30/96 7:43	5.4	7/30/96 7:51	6.54
7/30/96 14:03	-0.5	7/30/96 14:28	0.64
7/30/96 20:03	6.3	7/30/96 20:11	7.44
7/31/96 2:40	-1	7/31/96 3:05	0.14
7/31/96 8:36	5.6	7/31/96 8:44	6.74
7/31/96 14:56	-0.6	7/31/96 15:21	0.54
7/31/96 20:56	6.2	7/31/96 21:04	7.34
8/1/96 3:29	-1	8/1/96 3:54	0.14
8/1/96 9:30	5.7	8/1/96 9:38	6.84
8/1/96 15:47	-0.5	8/1/96 16:12	0.64
8/1/96 21:51	6	8/1/96 21:59	7.14
8/2/96 4:16	-0.9	8/2/96 4:41	0.24
8/2/96 10:27	5.7	8/2/96 10:35	6.84
8/2/96 16:39	-0.3	8/2/96 17:04	0.84
8/2/96 22:48	5.7	8/2/96 22:56	6.84

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Ewing, New Jersey 08618

ERM

Client: Standard Chlorine Chemical Company, Inc.		WO#: L7905.03.01	Boring/Well: SB-11
Project: Focused Remedial Investigation			
Date Started: 8/6/96	Date Completed: 8/6/96	Screen: NA	From: -To:
Logged By: F. Nemec	Checked By:	Pack: NA	From: -To:
Drilling Co.: JCA	Driller: S. Berger	Seal: NA	From: -To:
Method: Mud Rotary	Equipment: CME Rig	Grout: NA	From: -To:
Boring Depth: 16 ft.	Ground Surface Elevation: 3.56 ft.	Inner Casing: NA	
Initial GW Level: 8.0 ft.	GW Level: NA Time/Date NA	Outer Casing/Stick Up: NA	

Depth	Sample	Recovery	Blow Count	Headspace ppm	Lithology	Description	Remarks	Well Construction
0		12"	6,6,7,6	1		0-2 ft. - Orange-brown fine to medium sand and silt fill, trace fine gravel, moist, to 1.0 ft.; 1-2 ft. Dark brown silty clay, fine to coarse sand and gravel fill, very moist.		NA
2		24"	3,4,6,6	15		2-4 ft. - Dark brown fine to medium sand fill, some silty clay, some fine rounded gravel, very moist with sheen on soil.		
4		24"	19,20,31,40	3		4-6 ft. - Brown fine to medium sand fill, some silty clay, some fine rounded gravel, moist.		
6		12"	14,16,12,4	3		6-8 ft. - Same as previous to 7 ft.; 7-7.5 ft. Black organic silt and peat; 7.5-8 ft. Wood pieces (from meadow mat), very moist.		
8		0"	4,10,9,12			8-10 ft. - No recovery.		
10		14"	7,8,9,9	4		10-12 ft. - Dark gray fine to medium fairly well sorted sand, little silt, wet.		
12								

ERM
300 Phillips Boulevard, Suite 200
Ewing, New Jersey 08618

Client: Standard Chlorine Chemical Company, Inc.		WO#: L7905.03.01	Boring/Well: SB-11
Project: Focused Remedial Investigation			
Date Started: 8/6/96	Date Completed: 8/6/96	Screen: NA	From: -To:
Logged By: F. Nemec	Checked By:	Pack: NA	From: -To:
Drilling Co.: JCA	Driller: S. Berger	Seal: NA	From: -To:
Method: Mud Rotary	Equipment: CME Rig	Grout: NA	From: -To:
Boring Depth: 16 ft.	Ground Surface Elevation: 3.56 ft.	Inner Casing: NA	
Initial GW Level: 8.0 ft.	GW Level: NA Time/Date NA	Outer Casing/Stick Up: NA	

Depth	Sample	Recovery	Blow Count	Headspace ppm	Lithology	Description	Remarks	Well Construction
12		10"	9,10,10,12	2		12-14 ft. - Brown fine to medium fairly well sorted sand, trace silt, wet.		NA
14		12"	9,11,13,13	15		14-16 ft. - Same as previous to 15.5 ft. with 15-15.5 ft. interval saturated with DNAPL. 15.5-16 ft. Medium gray stiff clayey silt, damp to moist.		
16								
18								
20								
22								
24								

ERM
300 Phillips Boulevard, Suite 200
Ewing, New Jersey 08618

nt: Standard Chlorine Chemical Company, Inc.		WO#: L7905.03.01	Boring/Well: SB-12
roject: Focused Remedial Investigation			
Date Started: 8/7/96	Date Completed: 8/7/96	Screen: NA	From: -To:
Logged By: F. Nemec	Checked By:	Pack: NA	From: -To:
Drilling Co.: JCA	Driller: S. Berger	Seal: NA	From: -To:
Method: Mud Rotary	Equipment: CME Rig	Grout: NA	From: -To:
Boring Depth: 18 ft.	Ground Surface Elevation: 6.63 ft.	Inner Casing: NA	
nitial GW Level: 3.5 ft.	GW Level: NA Time/Date NA	Outer Casing/Stick Up: NA	

Depth	Sample	Recovery	Blow Count	Headspace ppm	Lithology	Description	Remarks	Well Construction
0		6"	7,1,2,3	0		0-2 ft. - Orange-brown silt and fine to medium sand fill, some fine to coarse angular gravel and cinders, damp.		NA
2		22"	3,2,2,2	0		2-4 ft. - Medium to dark gray fine to coarse sand fill, some fine to coarse gravel, some silt, moist, becoming wet at 3.5 ft.		
4		24"	8,6,10,12	0		4-6 ft. - Same as previous, wet.		
6		18"	4,8,9,11	1		6-8 ft. - Same as previous to 7.5 ft.; 7.5-8 ft. Gray silty clay fill, some medium to coarse sand, trace fine gravel, wet.		
8		24"	6,10,11,12	1		8-10 ft. - Medium gray fine to medium sand fill, some clayey silt, with white and green fine angular gravel throughout, wet.		
10		24"	4,4,3,4			10-12 ft. - Same as previous to 10.5 ft., grading to dark gray silty organic clay from 10.5-11 ft., soft, very moist. 11-12 ft. Dark brown peat (meadow mat) with some black staining from the organic clay, moist.		
12								

ERM
300 Phillips Boulevard, Suite 200
Ewing, New Jersey 08618

Client: Standard Chlorine Chemical Company, Inc.		WO#: L7905.03.01	Boring/Well: SB-12
Project: Focused Remedial Investigation			
Date Started: 8/7/96	Date Completed: 8/7/96	Screen: NA	From: -To:
Logged By: F. Nemec	Checked By:	Pack: NA	From: -To:
Drilling Co.: JCA	Driller: S. Berger	Seal: NA	From: -To:
Method: Mud Rotary	Equipment: CME Rig	Grout: NA	From: -To:
Boring Depth: 18 ft.	Ground Surface Elevation: 6.63 ft.	Inner Casing: NA	
Initial GW Level: 3.5 ft.	GW Level: NA Time/Date NA	Outer Casing/Stick Up: NA	

Depth	Sample	Recovery	Blow Count	Headspace ppm	Lithology	Description	Remarks	Well Construction
2		2"	1,1,1,1			12-14 ft. - Dark brown peat (meadow mat), little dark gray organic silt, moist.		NA
4		18"	5,5,9,10	2		14-16 ft. - Same as previous to 15 ft.; 15-16 ft. Light gray-brown fine sand and silt, grading coarser with depth, wet.		
6		16"	9,10,14,18	0		16-18 ft. - Medium reddish-gray well sorted fine to coarse sand, trace silt, wet.		
8		10"	21,18,16,14	0		18-20 ft. - Medium yellow-brown fairly well sorted fine to medium sand, trace fine rounded gravel, trace silt, wet.		
20		14"	6,6,5,7	0		20-22 ft. - Medium brown-gray silty clay, trace lenses of fine sand, very moist to wet.		
22								
24								

ERM
300 Phillips Boulevard, Suite 200
Ewing, New Jersey 08618

nt: Standard Chlorine Chemical Company, Inc.		WO#: L7905.03.01	Boring/Well: SB-13
roject: Focused Remedial Investigation			
Date Started: 8/12/96	Date Completed: 8/12/96	Screen: NA	From: -To:
Logged By: F. Nemec	Checked By:	Pack: NA	From: -To:
Drilling Co.: JCA	Driller: S. Berger	Seal: NA	From: -To:
Method: Mud Rotary	Equipment: CME Truck Rig	Grout: NA	From: -To:
Boring Depth: 16 ft.	Ground Surface Elevation: 4.27	Inner Casing: NA	
Initial GW Level: 3.0 ft.	GW Level: NA Time/Date NA	Outer Casing/Stick Up: NA	

Depth	Sample	Recovery	Blow Count	Headspace ppm	Lithology	Description	Remarks	Well Construction
0		0"	5,3,1,2			0-2 ft. - No recovery.		NA
2		10"	2,1,1,1	0		2-4 ft. - Dark brown fine to coarse sand fill, some fine to coarse angular gravel, some silt, wet beginning at 3 ft.		
4		14"	10,27,8,3	1		4-6 ft. - Same as previous to 5.5 ft.; 5.5-6 ft. Dark reddish orange silty clay and fine to coarse sand fill, some fine angular gravel, wet.		
6		8"	3,4,4,4			6-8 ft. - Black fine to coarse sand, gravel, and cinder fill, wet to 7.5 ft.; 7.5-8 ft. Black peat and organic silt (meadow mat), wet.		
8		10"	3,3,2,2,			8-10 ft. - Brown to dark brown same as previous, very moist.		
10		12"	3,3,3,4			10-12 ft. - Same as previous to 11.5 ft., wet; 11.5-12 ft. Medium gray clayey silt and fine sand, wet.		
12								

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Ewing, New Jersey 08618

ERM

Client: Standard Chlorine Chemical Company, Inc.		WO#: L7905.03.01	Boring/Well: SB-13
Project: Focused Remedial Investigation			
Date Started: 8/12/96	Date Completed: 8/12/96	Screen: NA	From: -To:
Logged By: F. Nemec	Checked By:	Pack: NA	From: -To:
Drilling Co.: JCA	Driller: S. Berger	Seal: NA	From: -To:
Method: Mud Rotary	Equipment: CME Truck Rig	Grout: NA	From: -To:
Boring Depth: 16 ft.	Ground Surface Elevation: 4.27	Inner Casing: NA	
Initial GW Level: 3.0 ft.	GW Level: NA Time/Date NA	Outer Casing/Stick Up: NA	

Depth	Sample	Recovery	Blow Count	Headspace ppm	Lithology	Description	Remarks	Well Construction
2		14"	8,11,11,13	2		12-14 ft. - Medium to dark gray poorly sorted fine sand, some silt, wet.		NA
4		18"	10,10,27,13	3		14-16 ft. - Same as previous to 15.5 ft., from 14-15.5 ft. the sand is micaceous and grading siltier with depth.; 15.5-16 ft. Medium reddish gray clayey silt/silty clay, occasional lenses of fine sand, moist to damp.		
6								
8								
20								
2								
4								

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Ewing, New Jersey 08618

ERM

Client: Standard Chlorine Chemical Company, Inc.		WO#: L7905.03.01	Boring/Well: SB-14
Project: Focused Remedial Investigation			
Date Started: 8/7/96	Date Completed: 8/7/96	Screen: NA	From: -To:
Logged By: F. Nemec	Checked By:	Pack: NA	From: -To:
Drilling Co.: JCA	Driller: S. Berger	Seal: NA	From: -To:
Method: Mud Rotary	Equipment: CME Truck Rig	Grout: NA	From: -To:
Boring Depth: 20 ft.	Ground Surface Elevation: 7.44 ft.	Inner Casing: NA	
Initial GW Level: 5.5 ft.	GW Level: NA Time/Date NA	Outer Casing/Stick Up: NA	

Depth	Sample	Recovery	Blow Count	Headspace ppm	Lithology	Description	Remarks	Well Construction
0		20"	3,4,4,4	0		0-2 ft. - Orange-brown fine sand fill, little silt, trace fine gravel, dry to damp, to 1.0 ft.; 1-2 ft. Dark reddish-brown and green silt and fine to medium sand fill, trace fine angular gravel, moist.		NA
2		14"	4,5,5,5	0		2-4 ft. - Same as previous, moist.		
4		24"	5,5,5,5	0		4-6 ft. - Same as previous, becoming wet at 5.5 ft.		
6		24"	6,8,10,12	0		6-8 ft. - Same as previous, wet.		
8		16"	8,6,5,3	0		8-10 ft. - Same as previous, wet to 9.5 ft.; 9.5-10 ft. Dark brown peat, some organic silt (meadow mat), moist.		
10		0"	3,3,3,3			10-12 ft. - No recovery.		
12								

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Ewing, New Jersey 08618

ERM

nt: Standard Chlorine Chemical Company, Inc.		WO#: L7905.03.01	Boring/Well: SB-14
roject: Focused Remedial Investigation			
ate Started: 8/7/96	Date Completed: 8/7/96	Screen: NA	From: -To:
ogged By: F. Nemec	Checked By:	Pack: NA	From: -To:
rilling Co.: JCA	Driller: S. Berger	Seal: NA	From: -To:
lethod: Mud Rotary	Equipment: CME Truck Rig	Grout: NA	From: -To:
oring Depth: 20 ft.	Ground Surface Elevation: 7.44 ft.	Inner Casing: NA	
itial GW Level: 5.5 ft.	GW Level: NA Time/Date NA	Outer Casing/Stick Up: NA	

Depth	Sample	Recovery	Blow Count	Headspace ppm	Lithology	Description	Remarks	Well Construction
2		16"	2,1,9,10	3		12-14 ft. - Dark gray-brown peat, some organic silt (meadow mat) to 13.5 ft.; 13.5-14 ft. Light greenish-gray fine sand, little silt, wet.		NA
4		16"	8,10,11,12	2		14-16 ft. - Same as previous to 15.5 ft; 15.5 - 16 ft. Light reddish-gray fine to medium sand, poorly sorted, some silt, very moist to wet.		
6		24"	7,8,12,8	3		16-18 ft. - Light reddish-brown fairly well-sorted fine to medium sand, little silt, trace fine rounded gravel, wet.		
8		18"	8,12,16,20	2		18-20 ft. - Same as previous to 19 ft.; 19-20 ft. Medium brown clayey silt/silty clay with trace fine sand lenses, very moist.		
0								
2								

Attachment 2
Monitoring Well and Soil Boring Survey Data

Attachment 2
Monitoring Well and Soil Boring Survey Data
Standard Chlorine
Kearny, New Jersey

Well No.	Coordinates		TOC Elev.*	Ground Surface Elev.*	Total Well Depth, ft.	Meadow Mat Surface Elev.*	Clay Surface Elev.*
	East	North					
MW-1L	602518.73	698067.65	8.54	6.18	21	-4.32	-13.32
MW-2L	602927.72	698010.82	7.36	4.45	19	-3.55	-12.55
MW-3L	602725.51	697722.83	5.29	3.36	18	-3.61	-12.14
MW-4L	603527.45	697957.15	7.28	5.19	18	-4.61	-12.81
MW-5L	602923.55	698260.23	6.14	3.71	17	-3.79	-11.29
MW-6L	603531.37	698540.14	6.82	4.19	16	-4.11	-11.31
MW-7L	603657.55	698602.08	6.90	4.25	16	-0.04	-11.24
MW-8L	603960.19	698755.40	8.58	5.78	19	-0.22	-11.22
MW-9L	604139.06	698262.42	10.09	7.55	21	-2.45	-11.70
MW-10L	603775.85	698104.42	8.12	5.31	16	-3.69	-11.19
MW-11L	603816.29	698489.69	7.88	4.74	17	-3.56	-11.86
MW-12L	603663.18	698342.52	6.99	4.52	17.5	-4.28	-11.23
MW-13L	603923.15	698375.52	11.59	9.01	22.5	-3.99	-12.49
MW-14L	604031.04	698567.13	7.99	5.82	18	-2.58	-10.68
MW-15L	603135.12	697843.83	6.40	3.9	16	-2.10	-11.60
MW-11U	603822.89	698493.74	7.20	4.64	7.50	—	—
MW-12U	603664.83	698337.61	8.13	4.55	6.50	—	—
MW-13U	603931.08	698380.01	11.26	9.14	11.50	—	—
MW-14U	604027.39	698573.33	8.27	5.59	7.50	—	—
MW-15U	603138.76	697842.67	6.44	3.85	6.00	-2.15	—
PZ-2	603482.51	697977.40	7.60	5.10			
PZ-4	603910.57	698724.52	7.20	4.70			
PZ-5	604079.29	698239.90		10.92			
SB-1	603377.21	697958.16	—	4.82	18	-5.18	—
SB-2	603978.07	698556.73	—	4.30	18	-5.70	—
SB-3	604000.97	698640.66	—	4.63	18	-1.37	—
SB-4	603606.48	698260.62	—	4.20	16	-1.80	—
SB-5	604073.22	698420.43	—	6.40	20	-3.60	—
SB-6	603968.84	698187.24	—	7.99	22	-2.01	-12.01
SB-7	603676.02	698608.18	—	4.17	18	—	—
SB-8	603790.84	698635.64	—	4.53	18	-5.47	-11.47
SB-9	603909.18	698703.83	—	4.50	16	-3.50	—
SB-10	603549.76	698446.44	—	4.19	18	-5.81	—
SB-11	603697.92	698247.72	—	3.56	16	-4.44	—
SB-12	603874.41	698220.58	—	6.63	18	-5.37	-13.37
SB-13	603758.53	698104.72	—	4.27	16	-3.23	-11.23
SB-14	604109.68	698242.04	—	7.44	20	-2.06	-11.56

Notes:

* All elevations are in feet Mean Sea Level (MSL)

Meadow Mat and Clay elevations estimated from monitoring well and soil boring logs.

TOC = Top of Casing

Attachment 3
Tidal Study Results and Hydrographs

Memorandum

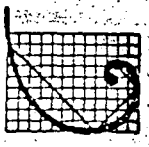
Environmental
Resources
Management, Inc.

To: Steve Montagna

From: Joan Kimsey

Date: 15 November 1996

Subject: Standard Chlorine - Tidal Study



ERM

Analysis of the tidal study conducted at the Standard Chlorine site in Kearny, New Jersey from 29 July 1996 through 3 August 1996 has been completed. Water levels were electronically recorded in monitoring wells MW-8L, MW-9L, MW-12U, MW-12L, MW-13L, MW-13U, PZ-3, PZ-4, and PZ-5. A complete set of electronic data files is attached.

Analysis

Tidal information was obtained from the tide table for the Hackensack River at New York, NY and adjusted for Kearny Point. The adjusted tidal information is shown on Table 1. Hand measured depth to water measurements are shown on Table 2.

The water level data for each well and tidal fluctuations are shown on the attached figures.

RESULTS

The tidal fluctuations generally did not effect on the ground water level at the site. The ground water levels in wells MW-12U, MW-12L, MW-13L, MW-13U, PZ-3, PZ-4, and PZ-5 were not influenced by the tide, as shown in the attached figures.

The only monitoring wells to show any tidal influence were MW-8L and MW-9L. The net rise or fall of the river in response to the tide is 5 to 6 feet. The amplitude of the water level fluctuations observed in the monitoring wells MW-8L and MW-9L to the tide were approximately 2.5 feet and 1 foot, respectively.

Hand Measured Depth to Water

MW-9L	TOC=	10.09	PZ-5	TOC=	10.92	MW-13U	TOC=	11.26	MW-13L	TOC=	11.59	MW-12U	TOC=	8.13
Time	DTW	Elev	Time	DTW	Elev	Time	DTW	Elev	Time	DTW	Elev	Time	DTW	Elev
7/29/96 11:05	9.06	1.03	7/29/96 11:08	9.30	1.62	7/29/96 11:11	7.05	4.21	7/29/96 11:13	9.75	1.84	7/29/96 11:18	4.73	3.40
7/30/96 10:43	8.82	1.27	7/30/96 10:42	8.80	2.12	7/30/96 10:48	7.07	4.19	7/30/96 10:46	9.69	1.90	7/30/96 10:23	4.77	3.36
8/1/96 10:34	8.75	1.34	8/1/96 10:32	8.86	2.06	8/1/96 10:52	6.76	4.50	8/1/96 10:51	9.41	2.18	8/1/96 10:48	4.52	3.61
8/2/96 13:02	8.67	1.42	8/2/96 13:00	8.80	2.12	8/2/96 13:04	6.69	4.57	8/2/96 13:07	9.51	2.08	8/2/96 13:15	4.57	3.56

Hand Measured Depth to Water

MW-9L	TOC=	10.09	PZ-5	TOC=	10.92	MW-13U	TOC=	11.26	MW-13L	TOC=	11.59	MW-12U	TOC=	8.13
Time	DTW	Elev	Time	DTW	Elev	Time	DTW	Elev	Time	DTW	Elev	Time	DTW	Elev
7/29/96 11:05	9.06	1.03	7/29/96 11:08	9.30	1.62	7/29/96 11:11	7.05	4.21	7/29/96 11:13	9.75	1.84	7/29/96 11:18	4.73	3.40
7/30/96 10:43	8.82	1.27	7/30/96 10:42	8.80	2.12	7/30/96 10:48	7.07	4.19	7/30/96 10:46	9.69	1.90	7/30/96 10:23	4.77	3.36
8/1/96 10:34	8.75	1.34	8/1/96 10:32	8.86	2.06	8/1/96 10:52	6.76	4.50	8/1/96 10:51	9.41	2.18	8/1/96 10:48	4.52	3.61
8/2/96 13:02	8.67	1.42	8/2/96 13:00	8.80	2.12	8/2/96 13:04	6.69	4.57	8/2/96 13:07	9.51	2.08	8/2/96 13:15	4.57	3.56

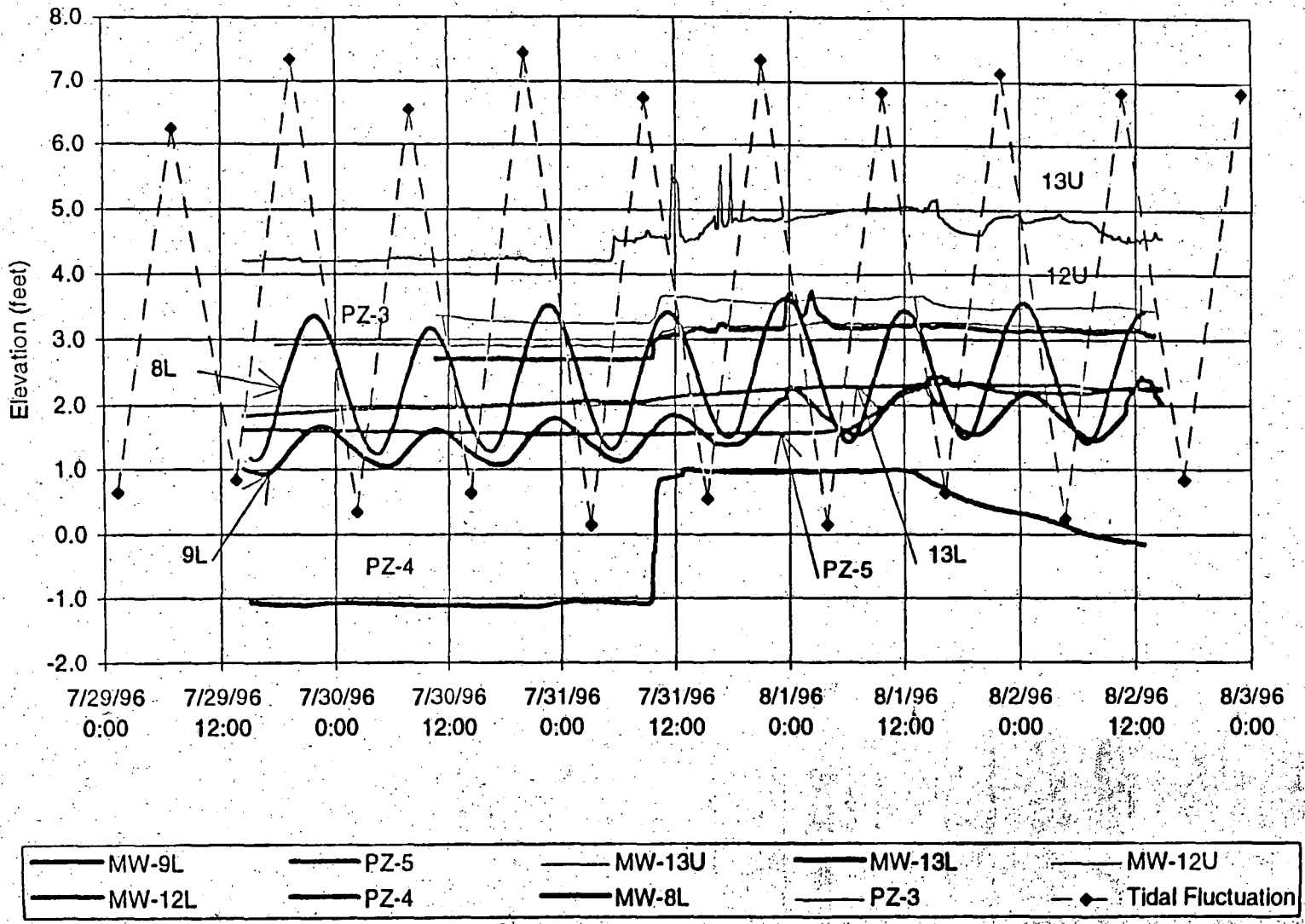
Hand Measure epth to Water

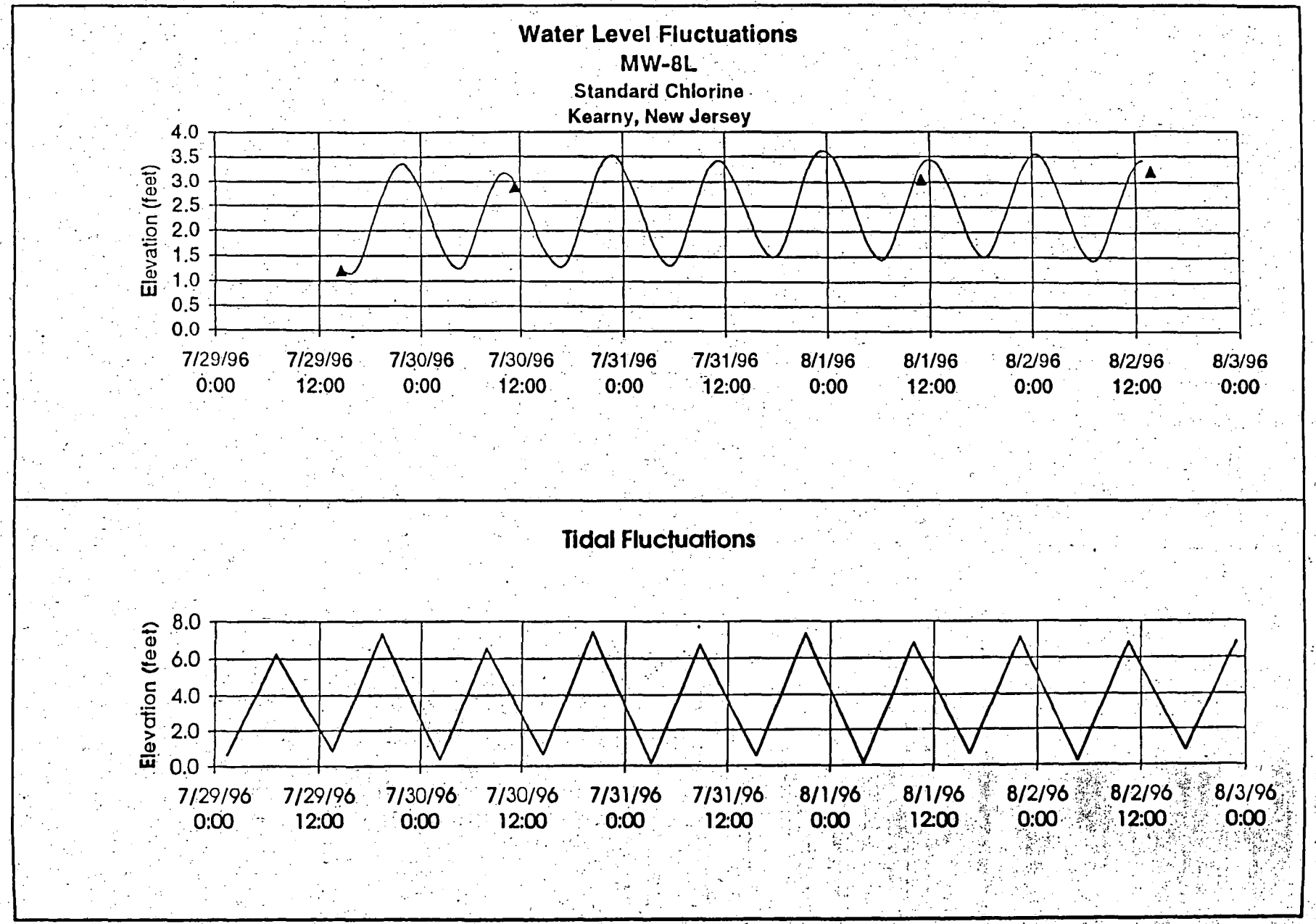
MW-12L	TOC=	6.99	PZ-4	TOC=	4.7	MW-8L	TOC=	8.58	PZ-3	TOC=	6.82
Time	DTW	Elev	Time	DTW	Elev	Time	DTW	Elev	Time	DTW	Elev
7/29/96 11:17	4.29	2.70	7/29/96 14:30	5.76	-1.06	7/29/96 14:34	7.38	1.20	7/29/96 16:36	3.89	2.93
7/30/96 10:20	4.77	2.22	7/30/96 10:52	5.78	-1.08	7/30/96 11:15	5.71	2.87	7/30/96 11:08	3.91	2.91
8/1/96 10:46	4.05	2.94	8/1/96 10:41	3.84	0.86	8/1/96 11:03	5.54	3.04	8/1/96 10:59	3.60	3.22
8/2/96 13:14	4.00	2.99	8/2/96 13:10	4.88	-0.18	8/2/96 13:47	5.38	3.20	8/2/96 12:43	3.68	3.14

Water Level Fluctuations

Standard Chlorine

Kearny, New Jersey



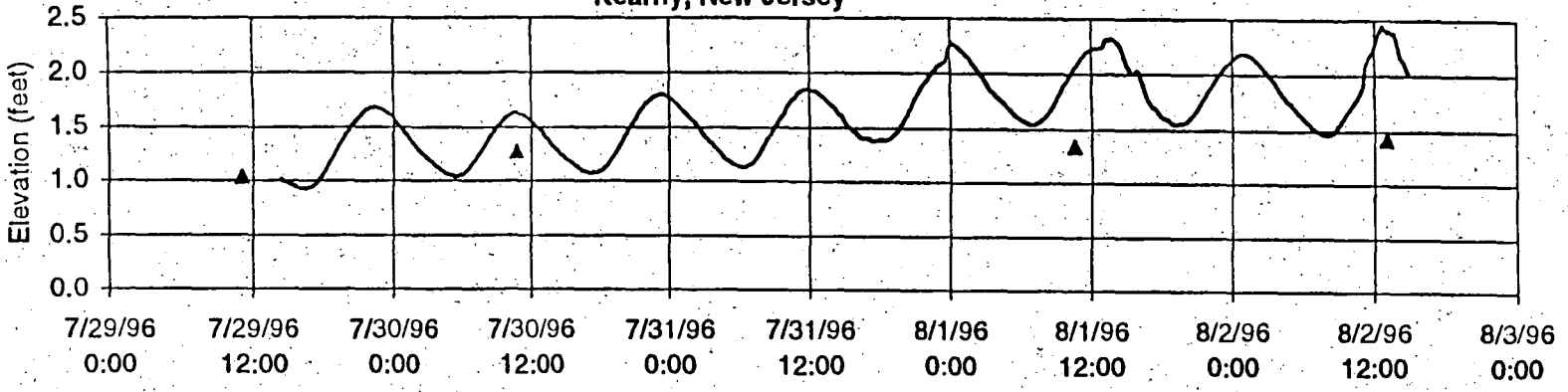

Water Level Fluctuations
MW-8L
Standard Chlorine
Kearny, New Jersey
Elevation (feet)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
7/29/96 0:00
7/29/96 12:00
7/30/96 0:00
7/30/96 12:00
7/31/96 0:00
7/31/96 12:00
8/1/96 0:00
8/1/96 12:00
8/2/96 0:00
8/2/96 12:00
8/3/96 0:00
Tidal Fluctuations
Elevation (feet)
8.0
6.0
4.0
2.0
0.0
7/29/96 0:00
7/29/96 12:00
7/30/96 0:00
7/30/96 12:00
7/31/96 0:00
7/31/96 12:00
8/1/96 0:00
8/1/96 12:00
8/2/96 0:00
8/2/96 12:00
8/3/96 0:00

Water Level Fluctuations

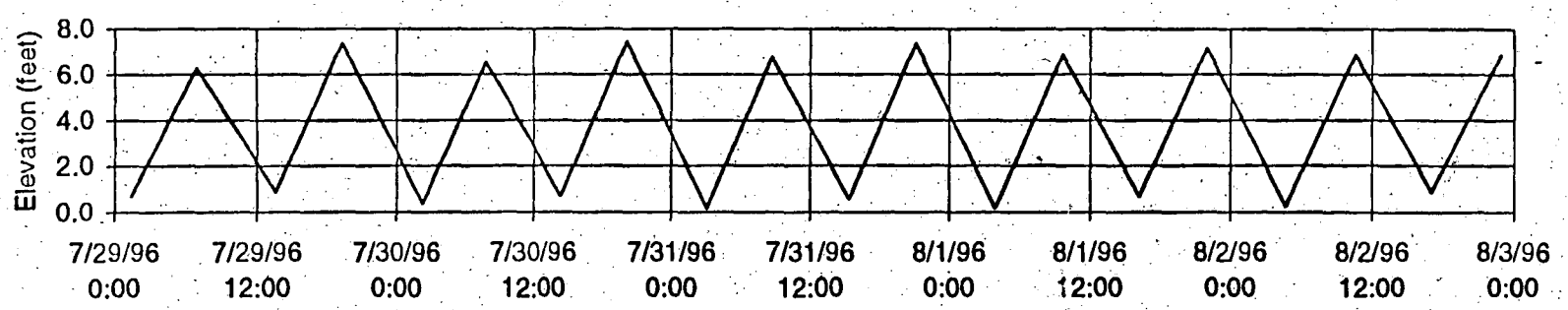
MW-9L

Standard Chlorine

Kearny, New Jersey



Tidal Fluctuations



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